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PROSTATIC HYPERTROPHY*

By CHARLES F. GESCHICKTER, M.D.

Surgical Pathological Laboratory, Department of Surgery, Johns Hopkins Hospital and University
BALTIMORE, MARYLAND

THE prostate gland includes within its capsule the deferential canal or ejaculatory ducts with a portion of the seminal vesicles which are of Wolffian origin, the prostatic utricle or uterus masculinus which is of Müllerian origin, the lobes of the prostate proper, the urethra and the small periurethral glands. Because of this complexity of structure, and because marked variations occur in the normal gland at different age periods, there is no single standard of comparison for pathologic change, and the interpretation of endocrine experiments performed on laboratory animals is difficult.

The beginnings of the prostate gland may be found in male human embryos of approximately 48 to 52 mm. crown-rump length (at about twelve weeks). The urethra distal to the bladder shows three pairs of downgrowing buds surrounded by a thick proliferating stroma. The deferential canal, the uterus masculinus and the future seminal vesicles are surrounded by a separate stroma which joins the stroma surrounding the urethra and its prostatic buds in the region of the verumontanum (Fig. 1). The separate embryologic origin of these two groups of glandular structures is important for the understanding of the normal physiology of the prostate, since it can be shown that they respond differently to endocrine stimuli.

The separate lobes of the prostate proper are best described in relation to the urethra and deferential canal. The junction of the deferential canal (ejaculatory ducts) with the urethra is marked by an eminence —the verumontanum. The posterior lobe of the prostate is behind or beneath the deferential canal and urethra and its ducts empty distal to the verumontanum (Fig. 2). Senile changes and cancer are most common in this lobe. The median lobe is between the deferential canal and urethra, and its ducts empty proximal to the verumontanum. Between the median lobe and the urethra are two groups of accessory glands; those nearest the bladder are termed the trigonal glands, and those nearest the median lobe the subcervical glands of Albarran. These suburethral or periurethral glands empty into the urethra between the bladder and verumontanum. Obstructive prostatic hypertrophy is often caused by changes in these glands. The two lateral lobes are to the right and left of the deferential canal and the ducts emerge on either side of the verumontanum. The anterior lobe is insignificant and on the opposite side of the urethra from the remaining lobes. There are numerous

* Aided by a grant from the Anna Fuller Fund. Read at the Thirty-seventh Annual Meeting, American Roentgen Ray Society, Cleveland, Ohio, Sept. 29–Oct. 2, 1936.

Fig. 1. Sagittal and cross sections of a 46 and 54 mm. human embryo showing the prostatic buds forming about the urethra. The cross section shows that the stroma about the prostatic urethra at this stage is separate from that of the utricle masculinus and ejaculatory ducts.

independent openings of these ducts into the urethra.

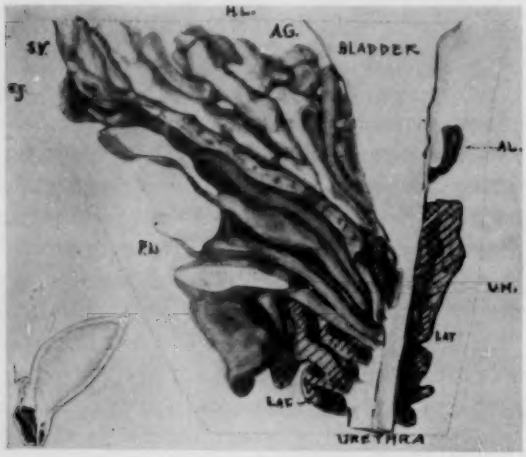

Fig. 2. Sagittal view of a wax model of the normal prostate at birth (after Lowsley—*Am. J. Anat.*, 1912). The large lateral lobe is behind the other lobes and the urethra. *S. V.*, seminal vesicles; *M. L.*, middle lobe; *E. J.*, ejaculatory ducts; *A. G.*, subcervical glands; *A. L.*, anterior lobe; *P. L.*, posterior lobe; *LAT.*, lateral lobe.

The prostate, which shows temporary enlargement and secretory changes at birth, is quiescent in childhood. The acini are collapsed and lined by flattened epithelium. Puberty growth begins between the ages of ten and twelve years and is usually complete at twenty years. During puberty the acinar structure changes (Fig. 3). The empty lumen, smooth walls, and lining of multiple rows of cuboidal cells are replaced by a widened lumen containing secretion, with papillary infoldings and tall columnar lining cells. This adult histology remains relatively constant from the age of twenty to forty years. Thereafter presenile and senile changes occur.

Presenile changes are characterized by atrophy of smooth muscle and increase of periacinar connective tissue, and by variations in the appearance of the epithelial structures. Many acini show hyperplastic changes. They become dilated, the papillary infoldings are lost or replaced by papillae with large cells which form epithelial

projections with occasional secondary luminar formation. Lining cells with hyperchromatic nuclei, scanty cytoplasm and occasionally without a basement membrane become more numerous. We have found secondary hyperplasia accompanying presenile changes in 40 per cent of 100 prostates of normal size between the ages of fifty and sixty years (Fig. 4). These changes were most frequent in the posterior lobe. In none of these cases was there any clinical or gross evidence at autopsy of enlargement or obstructive hypertrophy. Moore has confirmed by actual measurements in 129 cases that the normal prostate remains practically constant in size between the ages of twenty and ninety years. His description of presenile changes in the prostate correspond to the findings reported above. Moore, however, found secondary hyperplasia in 35 per cent of normal prostates after the age of forty. He does not emphasize acinar dilatation as a prominent feature of secondary hyperplasia. Moore found senile changes in the normal prostate most prominent after the age of sixty, characterized by flattening of the epithelium with the development of a sharp regular acinar border and a disappearance of secretory activity. Many acini collapse or are obliterated by the increase in hyalinized and sclerotic periacinar connective tissue. Corpora amylacea appear in increased numbers.

Fig. 3. Cross section of the normal prostate at puberty at the level of the verumontanum.

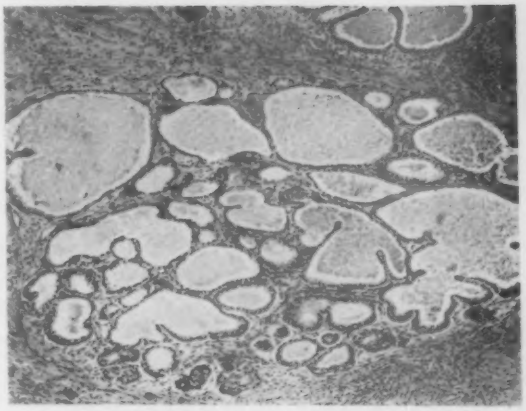

Fig. 4. Lobule of secondary hyperplasia from a normal adult prostate in a man aged sixty. In the upper portion of the lobule the acini are undergoing cystic changes. At the lower margin of the lobule new acini are being formed.

Correlations of Normal Changes with Endocrine Physiology. The dependence of normal growth and maintenance of the prostate upon testicular function was demonstrated by observations made on castrates, both animal and human prior to the present century (Lilienthal). In turn, testicular function (and through it the growth of the prostate) is dependent upon the pituitary gland (Smith). However, the type of cell in the testicle, and the particular testicular hormone responsible for prostatic growth has not been conclusively established. Nor is it established which of the cells or hormones of the anterior lobe of the pituitary gland act through the testicle to influence prostatic growth.

The influence of the cells of the seminiferous tubules upon the prostate can be ruled out apparently since these cells degenerate after ligation of the vas deferens, but atrophy of the prostate does not occur (Hanes). The increase in number and in prominence of the interstitial cells of the testis at birth, puberty and with senile hyperplasia suggests that these cells control the physiological changes of the prostate (Figs. 5 and 6). Ferguson, in 1933, in a study of 117 cases of teratoma testis, called attention to the diffuse enlargement of the prostate and seminal vesicles, ac-

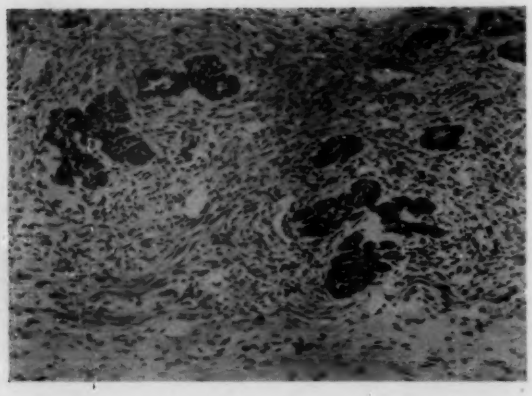

FIG. 5. Histology of the normal prostate from a seven months' premature infant. The prostatic tubules are undergoing terminal ramification but are without lumen. Stroma predominates.

companied by hyperplasia of the interstitial cells of the opposite testicle, varying in degree with the amounts of anterior pituitary-like substance recovered from the urine. However, it must be borne in mind that pathologic hypertrophy of the prostate affects usually a single portion of the gland in the periurethral region. It is focal in character; not a simple diffuse enlargement, and it cannot be assumed that the hormonal control of normal and pathologic growth are identical.

Pathology of Prostatic Hypertrophy. Obstructive prostatic hypertrophy in man results from focal changes in the periurethral portions of the gland. According to Thompson, 34 per cent of men over sixty years of age have hypertrophic changes in their prostates. On the other hand, Young has calculated that only 17 per cent show obstructive symptoms. These obstructive changes affect chiefly the glands between the verumontanum and the vesicle orifice. The region of the subtrigonal glands may be affected, producing the so-called median bar obstruction, or the suburethral portion of the median or both lateral lobes may be involved.

Microscopically the outstanding changes are cystic dilatation of the acini with papillary infoldings lined by a single layer of high columnar epithelium. Cysts lined by low cuboidal cells occur and spheroidal concretions result from secretory activity. Areas of epithelial hyperplasia may be found with increase in the number of acini. The stroma usually shows no marked increase (Figs. 7 and 8).

Hormonal Control of Changes in the Prostate. The majority of the sex hormones which have been available to date for experimental use have been shown to produce changes in the prostate. On the basis of experiments in mice and rats, conflicting theories of prostatic hypertrophy have been advanced. In the early experiments on mice and rats Brouha, Hinglais and Simonnet, Zondek, Lower and Johnston, and others, showed that the anterior pituitary-like hormone in pregnancy urine would cause enlargement of the prostate in non-castrated males. Attempts to reproduce these results in monkeys, however, have not been so successful because small, repeated doses have not proved as effective in these animals as in rats and mice. In early reports (again based on experiments in rats and mice) Lacassagne, Burrows, Zuckerman and Parkes, and others, concluded that prostatic hypertrophy with urinary obstruction was the result of changes induced by estrin. These changes were produced in male castrates. More recently, however, Weller, Overholzer and Nelson have shown that in rats and mice prolonged administration of estrin may act to decrease the size of the prostate, partly

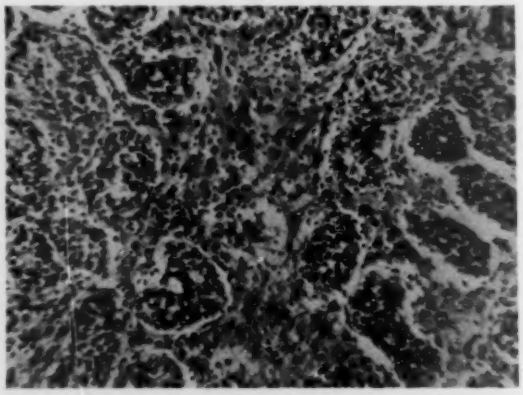

FIG. 6. Photomicrograph from a section of the testes of the premature infant shown in Figure 5. Note the prominence of interstitial cells.

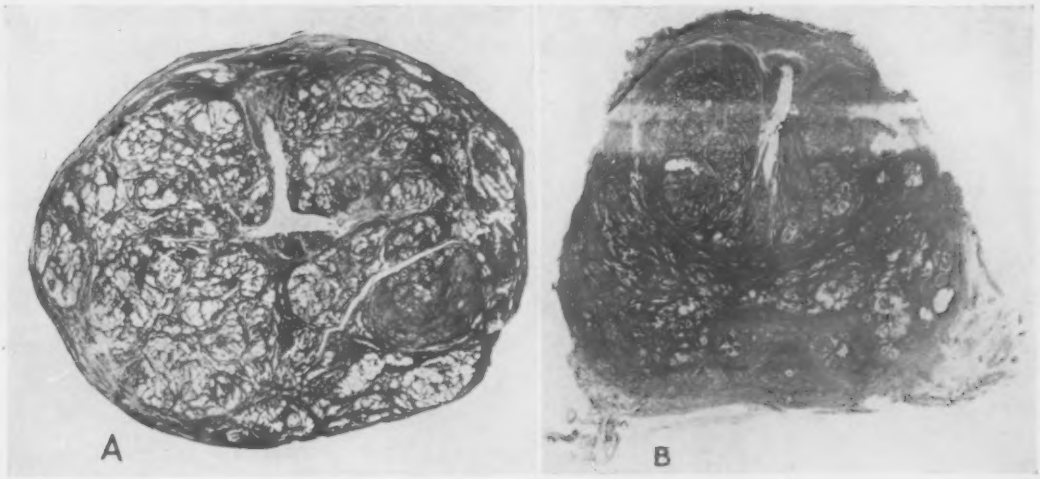

Fig. 7. Changes in prostatic hypertrophy. *A*. Photomicrograph of a cross section of a prostate showing diffuse hypertrophy of all lobes (after Wade, Young's Practice of Urology). Clinically this is unusual. *B*. Photomicrograph of a cross section of a prostate showing focal hypertrophy in the periurethral portions of the lateral and median lobes. Such periurethral changes are typical of prostatic hypertrophy.

as the result of action of estrin on the prostate but more probably because estrin in high dosage suppresses the activity of the anterior lobe of the pituitary. Van Wagenen, and Zuckerman and Parkes have analyzed the changes produced by estrin in the monkey and have shown that the chief effect is on the accessory prostatic structures resulting in squamous cell metaplasia in the structures about the verumontanum, including the utricle masculinus, the common ejaculatory ducts, accessory seminal vesicles and the lower half of the prostatic urethra. Increased cellularity of the stroma of the prostate may occur but the size of the prostate as a whole is usually not increased.

Enlargement of the prostate with increase in size of the seminal vesicles may be produced in castrated rats by the administration of testicular hormone. This reaction has been used for the assay of testicular hormone (testosterone). Zuckerman and Parkes have observed changes in the seminal vesicles and prostate of the monkey after injections of male sex hormones (androsterone and androstanediol). These authors concluded that these hormones promote rapid growth in the size of the seminal vesicles and prostate by acting both on their fibromuscular stroma (of the prostate) and on their individual glandular elements. The utricle masculinus was not affected. In our own experience (given below) the action of the male sex hormone (testosterone) has been more pronounced on the seminal vesicles than on the prostate.

While anterior pituitary gonadotropic substance, the ovarian hormone, estrin, and the male sex hormones have been shown to produce changes in the prostate,

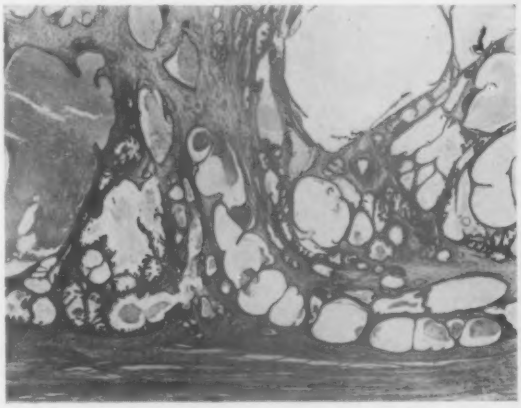

Fig. 8. Photomicrograph showing the characteristic microscopic changes of prostatic hypertrophy.

most of the experiments have been done on mice or rats. When these hormones have been administered to monkeys a selective influence usually on the accessory prostatic structures has frequently been

FIG. 9. Monkey c-1. Dilatation of the bladder and hypergenitalism accompanying experimental prostatic hypertrophy in the monkey following injections of pregnancy urine prolan (7,500 rat units in one week). *B*, bladder; *T*, testes; *P*, penis. The corresponding organs of the control animal are labelled *B'*, *T'* and *P'*.

obtained, and it cannot be claimed that the changes produced have corresponded to those observed in man in cases of clinical obstructive prostatic hypertrophy. More careful anatomical studies are needed on both the human and monkey prostate before satisfactory comparisons can be made of endocrine changes in the prostate of the two species. Despite the shortcomings of experiments to date, the majority of students in this field have concluded that prostatic hypertrophy in man is essentially an endocrine disturbance, although the exact nature and mechanism of the disturbance remains to be demonstrated (MacCallum).

Experimental Production of Prostatic Enlargement in Monkeys with Pregnancy Urine Prolan. Studies of the prostate before and after injection of sex hormones has been carried out in ten *Macacus* monkeys and in two *Cebus* monkeys. Autopsies had been performed on normal male monkeys of both species prior to these experiments for control purposes. Changes in the prostate were obtained with anterior pituitary-like hormone (pregnancy urine prolan) with estrone and with testosterone. The most striking changes were with pregnancy urine prolan. These changes affect more markedly the caudal lobe of the prostate of the monkey than the cranial lobe. The caudal lobe of the monkey prostate corresponds to the lateral and posterior lobes in the human. The cranial lobe of the monkey prostate corresponds in part to the median lobe of the human, though it is more intimately associated with the seminal vesicles (van Wagenen).

Three adult *Macacus* monkeys received 35,000 to 54,000 rat units of pregnancy urine prolan and one *Cebus* monkey received 7,500 rat units. The injections were given daily within a period of seven to ten days since, in our experience, short high doses produce optimal changes. These monkeys were not castrated although in one macaque one testis was removed prior to the injections. In the *Macacus* monkeys prior to the injections, a biopsy of the prostate was taken.

In non-castrated monkeys, receiving short high doses of pregnancy urine prolan, a diffuse enlargement of the prostate occurred. Such enlargement did not occur with more moderate prolonged doses (under 20,000 rat units) or when the animal had been castrated. Irradiation of the prostate (which also affected the testes) inhibited prostatic hypertrophy. When marked enlargement and cystic changes were produced in the prostate they were accompanied by hyperplasia of the interstitial

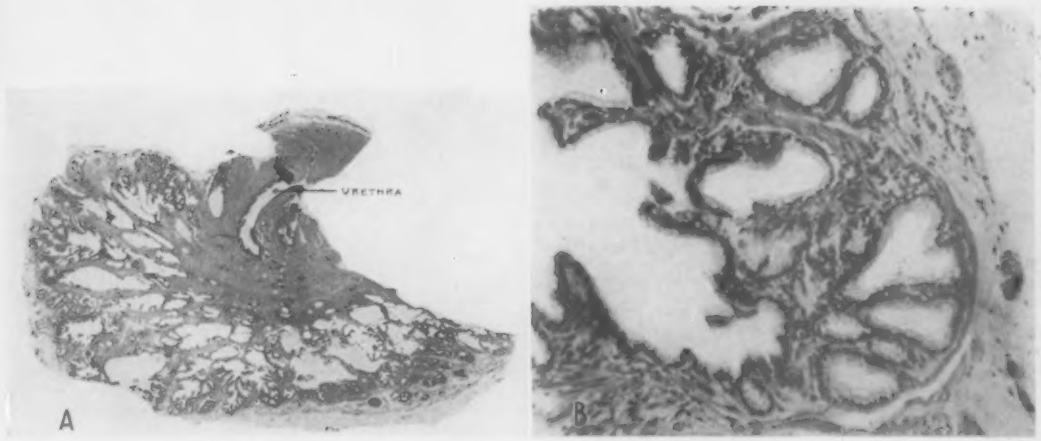

Fig. 10. Monkey c-1. Experimental prostatic hypertrophy after prolan injections. *A* is a cross section of one-half of the prostate showing diffuse cystic changes. Many of the acini have been ruptured. *B*. High power photomicrograph showing the character of the epithelial lining.

cells of the testicle, by urinary retention and by dilatation of the bladder. In one adult monkey (*Macacus* L-11) the enlargement was persistent and apparently progressive six months after the last injection. In another animal (*Cebus* C-1) marked hyperplasia of the interstitial cells of the testis was observed. The changes observed in these last two monkeys are given in detail.

Male Cebus C-1: This animal's weight was approximately 1,200 grams. Both testicles were about 1.5 cm. in their longest diameter and were in the scrotum. The penis was slightly over 1 cm. in length. No biopsies were taken before the injections. This monkey received 7,500 rat units of pregnancy urine prolan in four equal doses on alternate days within a period of one week. There was a severe reaction after the first injection. On the following day, the animal recovered and the injections were resumed. At the time of the fourth injection, the animal was in great pain and the penis and testicles were swollen. The animal was sacrificed ten days after the first injection.

At autopsy the bladder was found greatly dilated and filled with urine, the testes were nearly twice their former size. The penis measured 2.5 cm. The lobes of the prostate were enlarged and the maximum diameter of the gland was about twice that of the control. A comparison of these sexual organs with that of an animal of the same size which received injections of estrin is shown in Figure 9.

The histologic findings are striking—the prostatic acini and tubules are tremendously dilated. In places the walls of the acini have ruptured and large cysts have formed. There are numerous epithelial-lined papillae. The lining epithelium is columnar with an irregular secretory margin and only a single layer thick (Fig. 10). In the cystic portions there is a single layer of low cuboidal epithelium. The stroma is not increased. Here and there is a center of epithelial proliferation with many nuclei. This cystic dilatation of the gland is diffuse. It is

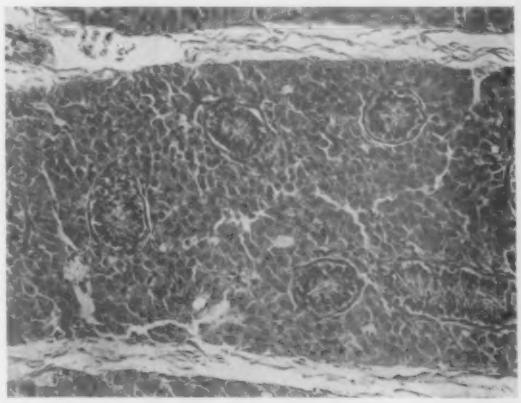

Fig. 11. Monkey C-1. Photomicrograph from a section of the testis following injections of prolan with diffuse experimental prostatic hypertrophy. Interstitial cells predominate. The seminiferous tubules are collapsed and show no spermatogenesis.

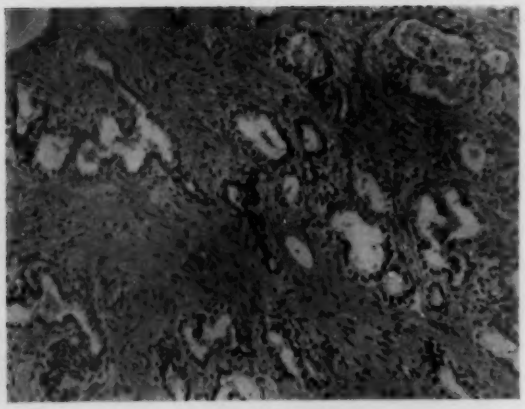

FIG. 12. Monkey L-11. Photomicrograph showing the histology of the prostate before injections, from a biopsy performed March 22, 1934.

maximal, however, in the midzone rather than at the periphery and more marked in the caudal than cranial lobes. The testicle shows a marked increase in interstitial cells. Although the testes of a control animal show spermatogenesis, there is none in the testes of the injected animal. The tubules are collapsed, and the enlargement of the testis is due to an increase in interstitial cells. In general, the picture is that of cryptorchism (Fig. 11). There is no proof that the testes of this animal were normal before the experiment, but there was unquestionably a rapid increase in the size of the penis, testes and prostate, with the development of urinary retention, and marked dilatation of the bladder.

Male Macacus L-11: This was an adult monkey weighing 7,390 grams. The prostate was biopsied (Fig. 12) and one testicle was removed on March 22, 1934, and on April 12 further biopsies were taken of the thyroid and breast. On April 28 daily injections of pregnancy urine prolan were begun. Between then and May 8, 34,000 rat units were administered. The prostate and remaining testicle were biopsied on May 11, 1934. At this biopsy the prostate and testicle were definitely enlarged beyond the size noted before injections. No further hormones were administered. The animal was sacrificed on November 3, 1934, six months after the last injection. At autopsy the testicle measured 7 cm. in its longest diameter compared with 5 cm. for the testis removed before injections. The prostate was markedly enlarged. Judging from palpation at previous biopsies it had doubled in size. The bladder was tremendously dilated and its wall was hypertrophied (Fig. 13).

The microscopic studies of the prostate showed progressive cystic hypertrophy. The control biopsy (March 22, 1934) shows a predominance of fibromuscular stroma (Fig. 12). The acini are small. Many of them are collapsed. They are lined by a single layer of cuboidal epithelium which are occasionally reduplicated. There are very few papillary infoldings. The biopsy at the end of the injections (May 11, 1934) shows cystic dilatation of the acini. There are numerous papillary infoldings. Many are lined by moderately tall columnar cells with irregular secretory margins; others by cuboidal epithelium. There is secretory débris within the lumen of the acini. The section of the prostate removed at autopsy (Nov. 3, 1934) shows even more marked cystic dilatation with numerous papillary infoldings. Relatively large cysts are formed. In many places there is rupture of the acini (Fig. 14*A*). The changes affect the periphery, the midportion and extend into but are less marked in the periurethral region. The caudal lobe is more strikingly affected than the cranial lobe. Most of the lining cells are cuboidal or flattened. There are scattered foci of epithelial proliferations.

FIG. 13. Monkey L-11. Photograph of the bladder opened at autopsy November 3, 1934, six months after the injection of 34,000 rat units of prolan. The progressive prostatic hypertrophy has caused urinary obstruction with dilatation and hypertrophy of the bladder.

The testis removed at the first operation for control (March 22, 1934) shows active spermatogenesis. The seminiferous tubules are occasionally separated by small spaces or thin strands of connective tissue. A few scattered interstitial cells can be found. In the biopsy removed immediately after the completion of the injections the seminiferous tubules are more widely separated. They show less active spermatogenesis. There is a slight increase in the number of interstitial cells. In the testis removed at autopsy there is lessened spermatogenesis. The majority of the seminiferous tubules are dilated and widely separated. Clumps of interstitial cells are scattered in between the tubules or applied to their outer margins. The number and size of these cells are moderately or slightly increased.

The unusual feature of this case is the apparent persistence and progress of the prostatic hypertrophy six months after the injection of hormones was stopped. The changes in the prostate are diffuse and affect mainly the acini, at the midportion and periphery of the gland (Fig. 14*A*).

That pregnancy urine prolan acts only through the testis and does not produce prostatic hypertrophy in small doses repeated over long periods is shown by a second group of experiments performed on immature monkeys (Monkeys A, B and C). The weights of these monkeys varied between 2,900 and 3,700 grams. The testes were not descended and showed spermatogenesis. Monkeys A and B received 19,000 rat units of prolan between February 7 and April 12, 1934, in small daily doses varying from 50 to 500 rat units. Neither the prostate nor the interstitial cells of the testis were markedly affected (Fig. 15). Monkey C was castrated and given 14,000 rat units of prolan within a period of a week, beginning nine days after castration. At autopsy the atrophy of the prostate had not been prevented. The prostate was represented only by a small group of glands between the seminal vesicles and the urethra.

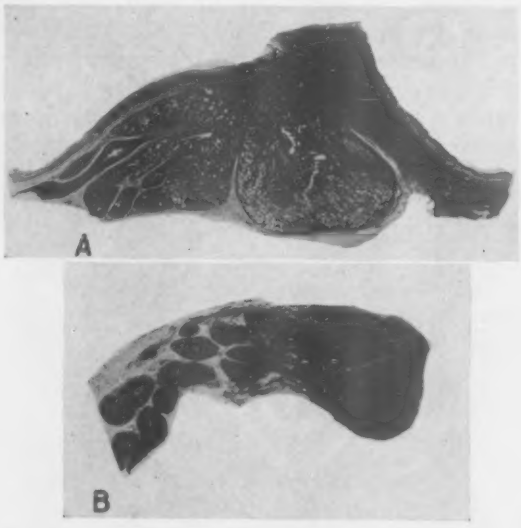

FIG. 14. Sagittal sections of the prostates of two monkeys with seminal vesicles. *A* shows the prostate of Monkey L-11, five months after the injection of 34,000 rat units of prolan. There is progressive cystic hypertrophy. *B* is a sagittal section of a control monkey of the same age—the magnification of the two sections is the same.

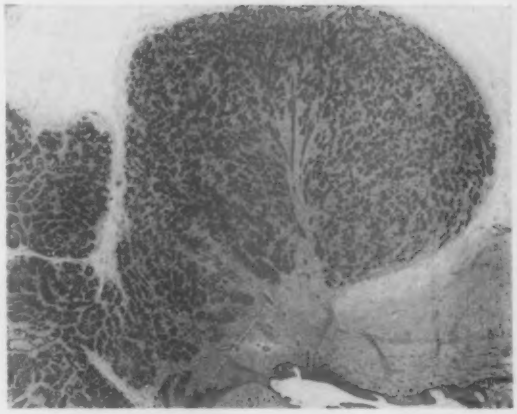

FIG. 15. Monkey A. Photomicrograph of a sagittal section of the prostate after the injection of 19,000 rat units of prolan over a period of two months (February 7, 1934 to April 12, 1934). The small prolonged doses of prolan have not resulted in hypertrophy.

The next experiment was performed to determine whether previous irradiation would prevent enlargement of the prostate in response to injections of pregnancy urine prolan. An attempt was made to irradiate the prostate without injury to the testis. However, the testes were subsequently proved to have been injured. The absence of prostatic enlargement following the injections apparently was due to the affect of irradiation on the testicle rather than on the prostate.

The prostates of two monkeys (G-8 and G-9) of approximately equal size and weight were irradiated with 200 r at a single dose through

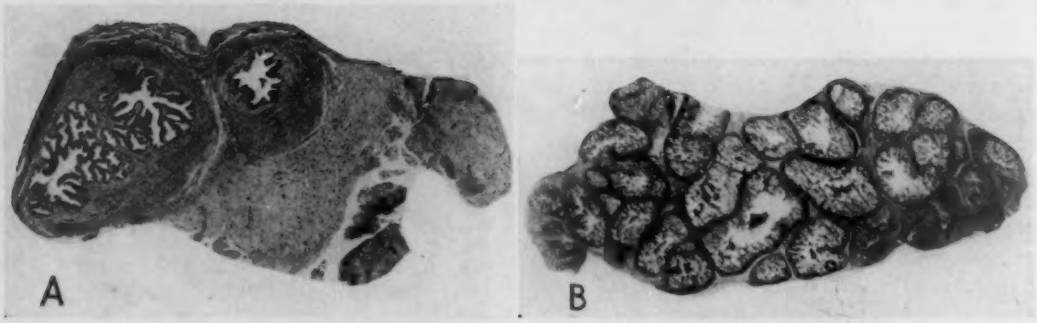

FIG. 16. Monkey G-8. Low power photomicrographs of the seminal vesicles before and after the administration of testosterone in a castrated monkey. *A* is a low magnification of the seminal vesicles before the injection of testosterone (September, 19, 1936). The testes had been injured by irradiation given September 19, 1936. One testis was removed November 4 and the other December 5, 1936. Between December 7 and 21, 75 mg. of testosterone was injected. *B* (same magnification as *A*). The seminal vesicles after testosterone are markedly dilated and there is a relative decrease in stroma.

the perineum on September 19, 1936. The irradiation factors were 200 kv. at 50 cm. distance, filtered through 0.25 mm. of copper. A small portal cut in lead, slightly larger than 1 cm. square, was used. The monkeys were anesthetized with nembutal and the testes shielded with lead. On the second day following irradiation, the prostate of G-8 was biopsied; G-9 died following the irradiation and the prostate and testes were removed and sectioned. The prostates of both monkeys showed slight edema with swelling of the stroma. There was degeneration of the cytoplasm of the prostatic epithelium and fragmentation of the lining of many of the acini. Many of the nuclei were vacuolated. The testes immediately following the irradiation showed persistence of spermatogenesis, but vacuolization of the nuclei next the basement membrane of the seminiferous tubules.

Between September 21 and 27, Monkey G-8 received 5,000 rat units of pregnancy urine prolan daily for a total of 35,000 rat units. On September 28, the prostate was again biopsied. At exploration the gland was smaller (about three-fourths of its original size). The testes on palpation and measurement were about the same as previously (5.0×3.5 cm.). Irradiation had prevented enlargement of the prostate in response to prolan injections. The last week in October, a second course of prolan injections of 35,000 rat units was given. On November 4,

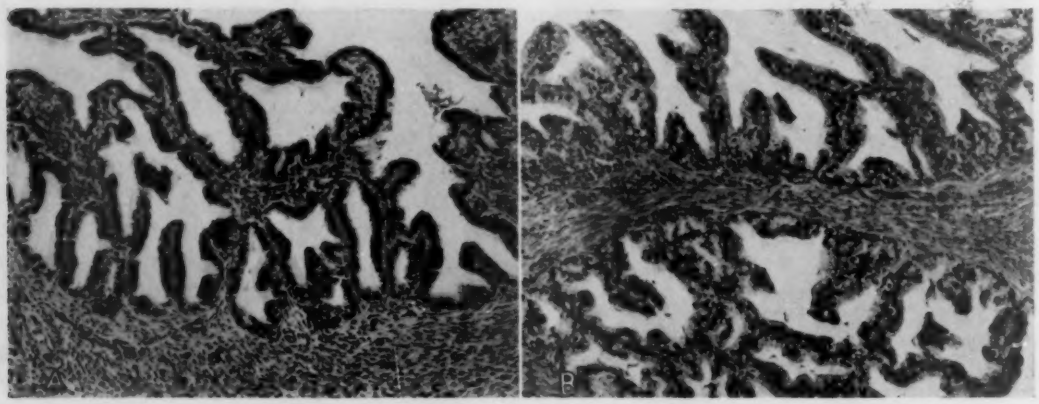

FIG. 17. Monkey G-8. The seminal vesicles before and after injections of testosterone. *A*. High power photomicrograph before injections. The nuclei predominate in the lining epithelium and the cellular stroma is prominent. *B*. After injections. The lining epithelium shows an increase in the cytoplasm. The number of papillary infoldings is increased. The stroma is relatively inconspicuous.

the prostate was palpated through a suprapubic incision and biopsy taken and one testicle was removed. The prostate and seminal vesicles were now about two-thirds of their original size. The testes measured only 3 × 2 cm., the tubules of the testis were collapsed, crowded together and showed no spermatogenesis.

One month later, December 5, the remaining testis was removed and the animal received 75 mg. of testosterone over a period of fifteen days (5 mg. daily). On December 21, the prostate and seminal vesicles were explored. In response to the testosterone injections there was a five-fold increase in the size of the seminal vesicles. They were matted together and completely obscured the prostate, which had not markedly increased in size (Figs. 16 and 17). A section of the prostate showed regeneration of the epithelium, the acini were lined with two or more rows of cells, the cells having prominent oval nuclei and scanty cytoplasm. The acini were moderately dilated but showed no evidence of secretion. Testosterone had restored the epithelial elements of the prostate in spite of the previous irradiation of the prostate and the absence of the testes. The most marked result of the testosterone, however, was the tremendous increase in size of the seminal vesicles (Figs. 16 and 17).

Effect of Estrin and Testosterone on the Monkey Prostate. The comparative effects of moderate and high doses of estrin on the monkey prostate were studied in two animals (Figs. 18 and 19). In two other animals the effects of testosterone in moderate and high doses were studied, the former on a castrated, the latter on a non-castrated immature monkey. Moderate doses of estrin (25,000 international units over a period of ten days) resulted in increase of the fibromuscular stroma of the prostate, dilatation of ejaculatory ducts and seminal vesicles and a slight increase in the transitional lining cells of the prostatic urethra. The lumina of the prostatic acini were dilated and lined with columnar epithelium. With high doses of estrin (1,500,000 i.u. over a period of one month) the size of the prostate was diminished. The ejaculatory ducts were dilated but the seminal vesicles showed thickening of the muscular wall without increase in the size of the lumen or epithelial changes. The transitional epithelium of the prostatic urethra showed hyperplasia, the lining layers being increased by ten or more rows (compare Figs. 18 and 19).

Testosterone acts on the prostate and seminal vesicles of both castrated and non-castrated monkeys. There is no noticeable enlargement of the prostate with testo-

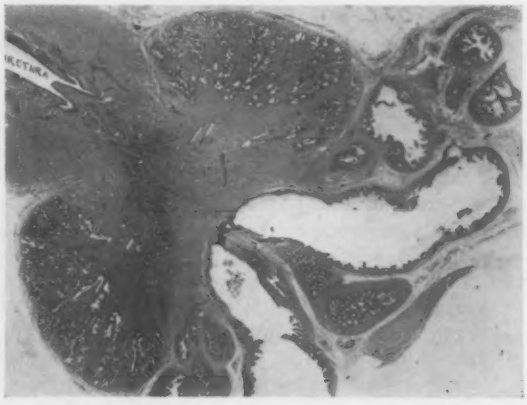

Fig. 18. Whole section of the prostate of a *Cebus* monkey receiving 25,000 international units of estrin (amniotin, Squibb) in a period of ten days. There is dilatation of the seminal vesicles, increase in the stroma and metaplasia in the epithelium of the prostatic urethra.

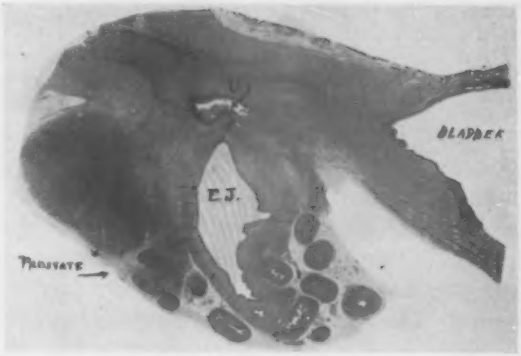

Fig. 19. Cross section of the prostate of the seminal vesicles of an immature *Macacus* monkey receiving 50,000 international units of estrin (Progynon-B Schering) daily except Sundays, for a total of 30 injections. The prostate has diminished rather than increased in size. The prostatic urethra (*U*) is almost occluded by squamous cell metaplasia and hyperplasia, the ejaculatory ducts (*E.J.*) are greatly dilated.

sterone in these experiments, although in the castrated monkey (G-8) the prostatic epithelium was restored after a preceding atrophy by the injections. The most marked effect is that on the seminal vesicles (Fig. 16, *A* and *B*). There is tremendous cystic enlargement with a relative and absolute decrease in the fibromuscular stroma. The enlargement of the seminal vesicles appears to be directly in proportion to the amount of testosterone given. In the animal receiving 75 mg. testosterone (5 mg. daily for fifteen days), there was a five fold increase in the size of the seminal vesicles. In the animal receiving 450 mg. of testosterone (5 to 10 mg. daily for a period of seven weeks), the seminal vesicles were approximately fifteen times their normal size and weight.

Parkes and Zuckerman reported the results of the administration of progesterone in monkeys which also received estrin or testosterone. They found that progesterone prohibited the effect of estrin or testosterone on the monkey prostate.

SUMMARY

These experiments seem to indicate that diffuse enlargement of the prostate histologically similar to prostatic hypertrophy in the human can be produced by an anterior pituitary-like hormone acting through the interstitial cells of the testis. High doses of the hormone administered over a period of seven to ten days produce maximal results. Removal of the testis or injury of the testis or prostate by irradiation prevents the prostatic response to this hormone. The prostatic enlargement produced experimentally in the monkey is diffuse and not focal. It is accompanied by urinary obstruction and is maximal in the midregion of the caudal lobe of the gland. Focal or suburethral hypertrophy such as is seen in the human has not been observed. Testosterone restores the prostatic epithelium after castration in the monkey. Its predominant effect, however, is an enlargement of the seminal vesicles, and its action differs from that of a normal interstitial cell under the influence of anterior pituitary-like stimulation. The effect of estrin on the prostate varies with dosage. Moderate doses produce slight enlargement by increase of the fibromuscular stroma, whereas large doses decrease the size of the prostate apparently through pituitary suppression. Further studies are necessary to determine the exact correlation between the prostatic structures of the monkey and the human before it can be claimed that the experimental results parallel those observed clinically and pathologically.*

* I wish to acknowledge with thanks the generosity of E. R. Squibb and Sons for the estrin (amniotin) used in these experiments, and the generosity of the Schering Corporation and the CibaCompany for the testosterone (oreton and perandren) used.

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DISCUSSION

Dr. E. Perry McCullagh, Cleveland, Ohio. I have enjoyed Dr. Geschickter's presentation immensely. It is a branch of endocrine research in which Dr. Roy McCullagh has been particularly interested, and naturally I have been interested in the developments that have come about.

I was very much interested indeed in the type of prostatic hypertrophy which Dr. Geschickter has been able to show can be produced by injections of antuitrin S. I cannot follow exactly his interpretation of the cause of such prostatic hypertrophy, since I gathered from what he said that this mechanism is similar to that which may occur in the human, and yet at the same time it is divorced from the theory of over-production of estrin or of another endocrine abnormality which has been postulated by Roy McCullagh as a possible cause of hypertrophy of the prostate in the human.

In looking over the manuscript, although it wasn't mentioned specifically in the talk, I noted that Dr. Geschickter thought that the inhibin theory of prostatic hypertrophy is based upon the theory that an excess of estrin causes the type of prostatic hypertrophy which is seen in the human. This is not the postulate on which such a theory is based, rather it is more on such findings as these: As Mortimer and Kramer showed long ago, if the tubules of the testes are damaged by irradiation, the pituitary gland can be shown to hypertrophy, and in such cases when this work has been repeated there is no atrophy of the accessories such as is seen following destruction or removal of the interstitial cells. Also if the testes are placed in the abdomen so that the gametogenic elements are not active, the pituitary becomes hypertrophied and can be shown to be hyperactive by experiments with transplantation. Here the interstitial cells are still active as shown by maintenance of the secondary sex glands.

Prostatic hypertrophy can be produced experimentally in similar animals in the absence of the pituitary by the injection of antuitrin S and similar substances, but it is not known definitely to be exactly the same type of prostatic hypertrophy as was shown in these monkeys that had the very high doses.

A possible explanation of human prostatic hypertrophy is that if these theoretical substances which are intimately connected with the gametogenic elements of the testes tend to disappear in the later years of life, the pituitary gland will hypertrophy and we will get a mechanism similar to that which Dr. Geschickter has shown in the monkey: an overproduction of the pituitary sex hormone and stimulation of interstitial cells with enlargement of the prostate and other glands.

I was particularly interested in Dr. Geschickter's explanation of what was found in the testes of these animals which were injected with very large quantities of pituitary-like hormone. He pointed out, as you remember, that the gametogenic elements were largely destroyed, and this, therefore, would be quite in keeping with our theory and findings that the inhibitory substance which is intimately connected with the gametogenic cells might have been removed by such treatment, and in this way the pituitary glands of these animals would be hyperactive and would retain their hyperactivity after the injection had been stopped, maintaining the masses of interstitial cells which had been formed and maintaining the prostatic hypertrophy. I think this is a possible explanation which warrants further investigation.

It would be very interesting to know actually what could be found regarding the activity of the pituitary glands after such experimental stimulation with antuitrin S.

Laquer's theory is not to be forgotten. Laquer has concluded from his studies that there is a distinct functional disproportion between the amount of estrin and the amount of interstitial cell hormone in the urine of men who have prostatic hypertrophy, and it is due to the estrin and the estrin effect that the hypertrophy occurs in the cells of the prostate. It is for this reason that he has tried and is reporting good results in the use of testis hormone. I think from what we know of the primary effects of these substances in animals that such treatment must surely be used with the greatest possible caution. I think estrin, too, must be used with caution because we know that it is capable under certain conditions of producing hypertrophy of the cells about the prostate.

The explanation of the effects of irradiation of the prostate was certainly extremely interesting and sounds very promising if used, as Dr. Geschickter pointed out, at the proper time in prostatic hypertrophy in the human.

Another point that he will probably elucidate in further experimentation in this work is whether he can change the prostatic hypertrophy by irradiation in monkeys after it has once been caused by such treatment as he has shown. The one drawback that I see to such treatment is that it is more or less symptomatic. It is, of course, directed toward the point at which attention to pathology is chiefly focused, but if we can show with greater certainty that the mechanism is related to pituitary sex hormone and interstitial cell hormone, I think that a good deal more consideration ought to be given to the possible effect of radiation treatment to the pituitary, with an attempt to cut down the pituitary sex hormone production in such instances.

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ESOPHAGEAL VARICES

By ALBERT OPPENHEIMER, M.D.
Department of Roentgenology, American University of Beirut
BEIRUT, LEBANON, SYRIA

ROENTGENOLOGICAL demonstration of esophageal varices has been shown to have its use in throwing light upon cases presenting vague abdominal symptoms with doubtful clinical and laboratory findings. Although the roentgenological appearances of this condition have already been described, especially by Berg, and by Schatzki in his excellent monograph, the observations which follow are given in the hope that they may add something of significance to a subject which has received relatively little attention. These observations are based on a six years' study of healthy students and of about 100 patients with esophageal varices, all of whom were thoroughly examined both clinically and roentgenologically. The observations will show that it is often unsafe, even in routine examinations, to neglect the consideration of functional factors which determine, to almost the same extent as anatomical formations, the roentgenological appearance of organs as presented on the film.

It is of interest, therefore, to remember that, in the esophagus, the passage of solid substances is different from that of fluids (Cannon). While the active peristaltic push is essential to the motion of solid food, the flow of fluids through the tube is essentially passive and due to gravity (Schreiber). It is facilitated by a "receptive relaxation" which, preceding the fluid, widens the esophageal lumen. When roentgenoscoping a healthy person drinking a glass full of opaque fluid in the erect position, it is easy to observe that, in general, no peristaltic activity deforms the opaque column of the esophageal shadow until almost the whole amount has left the tube. Then, after a few seconds of relaxation (Payne and Poulton), one or two tonic contractions narrow the lumen (Oppenheimer). Beginning at the upper end of the esophagus, they progress steadily and rapidly downward as though the esophphagus were being stripped or milked. These contractions expel only those residual particles which were retained in the folds of the mucosa. A slight rewidening of the lumen follows and persists throughout an indefinite period of observation. This represents the normal tone of the resting esophagus. In this condition, the width of the lumen is the same as during the short interval between swallowing and stripping.

In the recumbent position, gravity as a motor factor is excluded, with the result that there is, in this given condition, no difference in principle between the passage of solid and of fluid material. In either case the food, once pushed into the tube by the powerful constriction of the pharyngeal muscles, is carried towards the cardia by peristaltic waves which are very similar to the gastric waves in form, strength and rate. After a few seconds of rest, these are regularly followed by the terminal tonic stripping contractions. Afterwards the esophagus remains at rest unless empty swallowing produces moderate activity.

The effect of gravity being excluded, the rate of passage depends on the consistency of the material swallowed and on the peristalsis of the tube. Using a uniform material, the rate of passage in the recumbent position will depend on the peristalsis only. The latter, according to physiological rules (Alvarez, Cannon, Trendelenburg), depends mainly on two factors: first, the size of the individual bolus, and, secondly, the tonicity of the esophageal walls. The tone remaining constant, a larger bolus excites more active peristalsis, and vice versa; whereas, if the size of the bolus remains constant, it is the tonic-

ity of the esophagus which determines the degree and rate of peristalsis. Therefore, in the study of esophageal activity, it is essential to eliminate, so far as possible, all but one variable by administering opaque material of uniform composition in constant amount, at one time and in the recumbent position.

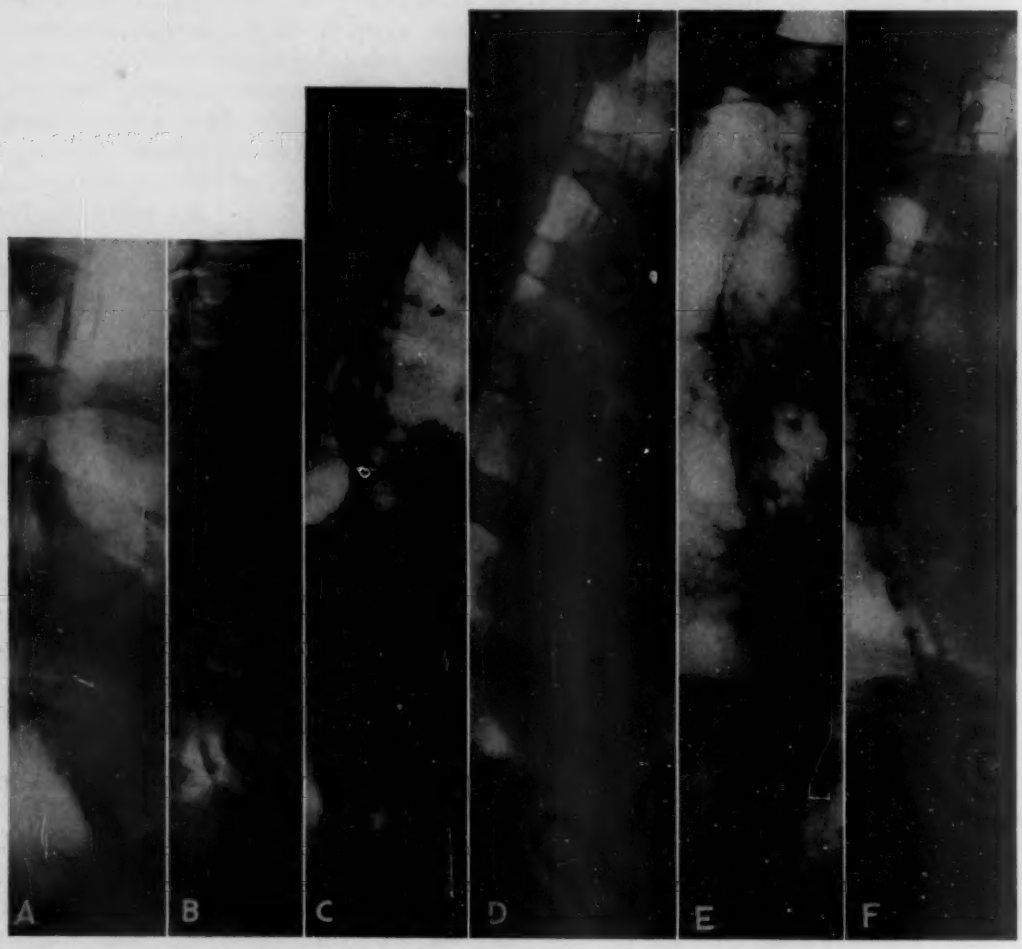

Fig. 1. Different aspects of esophageal varices in different patients. *A* and *B* show very early stages; *C*, moderately advanced; *D*, *E* and *F*, advanced varicosis.

There remains, however, one variable: the irritability of the mucous membrane. It has been shown by Kahn, Meltzer, Wassilieff, and others, that the normal sensibility of the pharyngeal and esophageal mucosa is essential to the control of swallowing. Previous studies have given me the impression that the mechanical irritation of the lower end of the tube is to some extent responsible for the normal relaxation of the cardia. Regardless of the actual tone of the esophagus, mechanical stimulation of this area often results in opening of the cardia.

Barclay and Anrep have demonstrated that negative pressure may play an important part in normal swallowing. Barclay, therefore, attributes but little importance to gravity as a motor, or to posture as a variable factor. His results, however, apply to solid and semifluid materials, while the observations here described apply to fluids only. Individual variations in the act of swallowing have been observed; they

will occasionally alter the usual roentgenological appearance of the organs concerned. There is, however, no doubt that in the erect position the passage of fluids through the tube depends chiefly on gravity. Under these conditions, retardation of the passage through the tube is almost invariably due to a delayed relaxation of the cardia.

METHOD

One tablespoonful of "unibaryt" is thoroughly mixed with two tablespoonfuls of lukewarm water. The consistency of this suspension corresponds approximately to that of cocoa made with milk. In case plain barium sulphate is used, the addition of a protective colloid, for example the yolk of one egg, is recommended. Both unibaryt and the egg mixture absorb easily small amounts of mucus, saliva and secretion, thereby producing a uniform homogeneity which is in general not obtained with plain barium sulphate suspension.

Before the opaque mixture is given to the patient, he is placed on the Potter-Bucky table, recumbent, with his left side towards the film. The angle which he should subtend with the table varies from 45° in average persons to 70° or 80° in those with flat chests, in order to avoid overshadowing the esophagus by the heart or spine. After the patient has relaxed and found a comparatively comfortable position, he is given instructions about swallowing and holding his breath. One tablespoonful of the opaque fluid is then given. An exposure is made five seconds after the patient has swallowed while he holds his breath in the position of forced inspiration. With this technique most films give a satisfactory result at the first attempt. In some cases, however, the film will show a peristaltic wave covering a diagnostically essential part of the tube, and the exposure should then be repeated after a slightly longer interval. Roentgenoscopy may precede or follow; polygrams are taken at various angles if necessary.

ROENTGEN FINDINGS

a. Roentgenoscopic. Compared with the detailed evidence of esophageal varices presented on the film, the roentgenoscopic findings are relatively vague. Personally, I have rarely been able to identify varices

Fig. 2. A case of early varicosis showing progressive enlargement of the varicose veins. (There is a six weeks' interval between *A* and *B*.)

during roentgenoscopy except in advanced cases. There is, however, one constant sign in gastroenterological routine examinations which should lead to further study of the esophageal mucosa, i.e. the retardation of the flow in the lower portion of the tube. It is often accompanied by a more or less marked broadening of the esophageal shadow. Even in early stages, when the roent-

genographic findings are still indefinite, this delay is regularly present. It is then caused by a slight retardation of the relaxation of the cardia: the opaque fluid seems to hesitate from five to ten seconds before entering the stomach. In more advanced stages, the prominent veins produce a partial obstruction. The venous enlargement also causes an increase in the total diameter of the esophagus. This, however, may be somewhat irregular, since it is due to the barium filling the interstices. In these advanced cases particles of barium are held in the folds above the bulging veins after the main portion has passed through, and produce the characteristic relief found on the film. The particles may remain visible for a considerable time, often for several hours. This retention is not only a mechanical phenomenon due to the irregular narrowing of the actual pathway, but it is also a

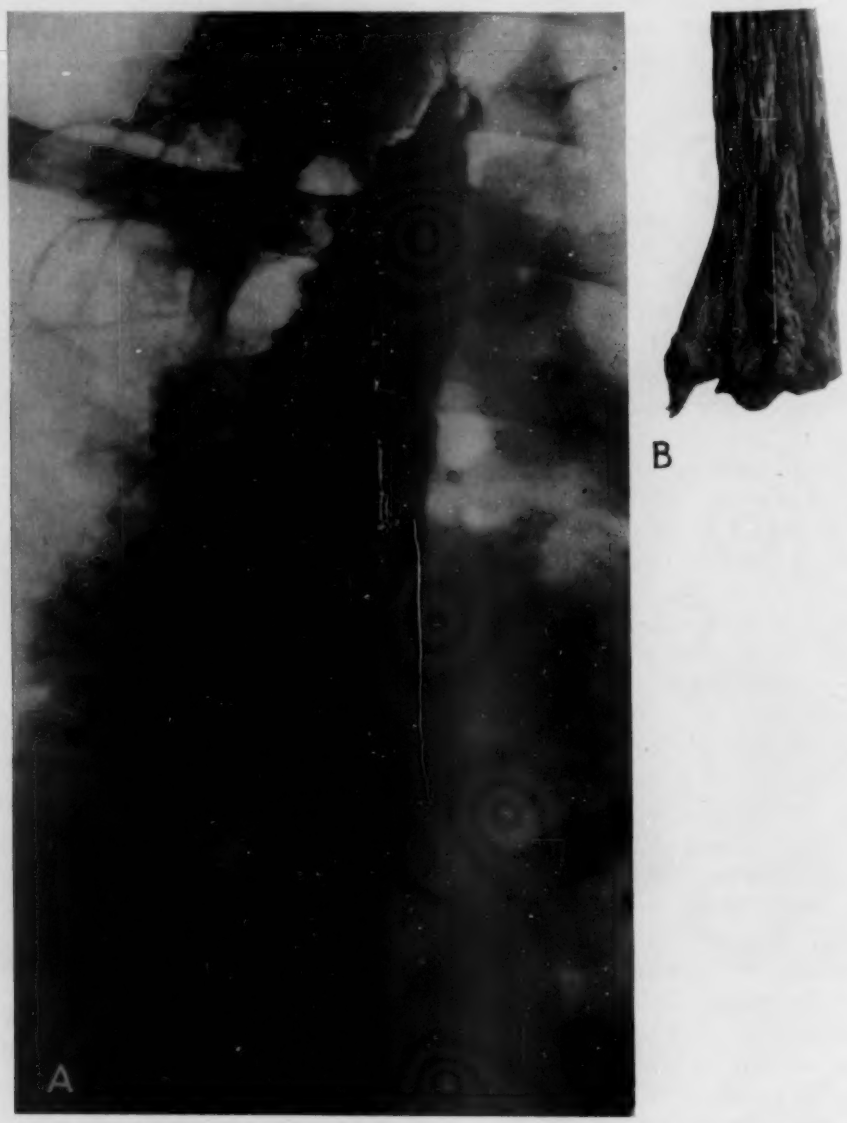

Fig. 3. A case of excessive varicosis referred to in the text. *A*, roentgenogram taken two days before the death of the patient; *B*, necropsy specimen.

functional disturbance, since the stripping peristalsis which normally removes residual particles becomes progressively less pronounced with increasing varicosity. In terminal stages, peristalsis may even be entirely absent and the tube seem atonic. Dilatation is then more pronounced than the obstruction caused by the varicose mass. After a short initial relaxation, the cardia, in these cases, may remain closed for hours. The roentgenoscopic aspect of this condition is then identical with that of the so-called cardiospastic dilatation of the esophagus

It is obvious that the slowing down of the passage through the esophagus is more marked in the recumbent position; but even in early stages the retardation in the lower portion of the tube is so definite that it is regularly seen in the erect position as well. Evidently this esophageal stasis is produced by two different factors, namely, by mechanical retention by the varicose mass, on the one hand, and by delayed relaxation (achalasia) of the cardia, on the other. In very early as well as in terminal stages, the delayed or absent relaxation of the cardia appears to be the only cause of retention. In extensive varices the mechanical retention predominates.

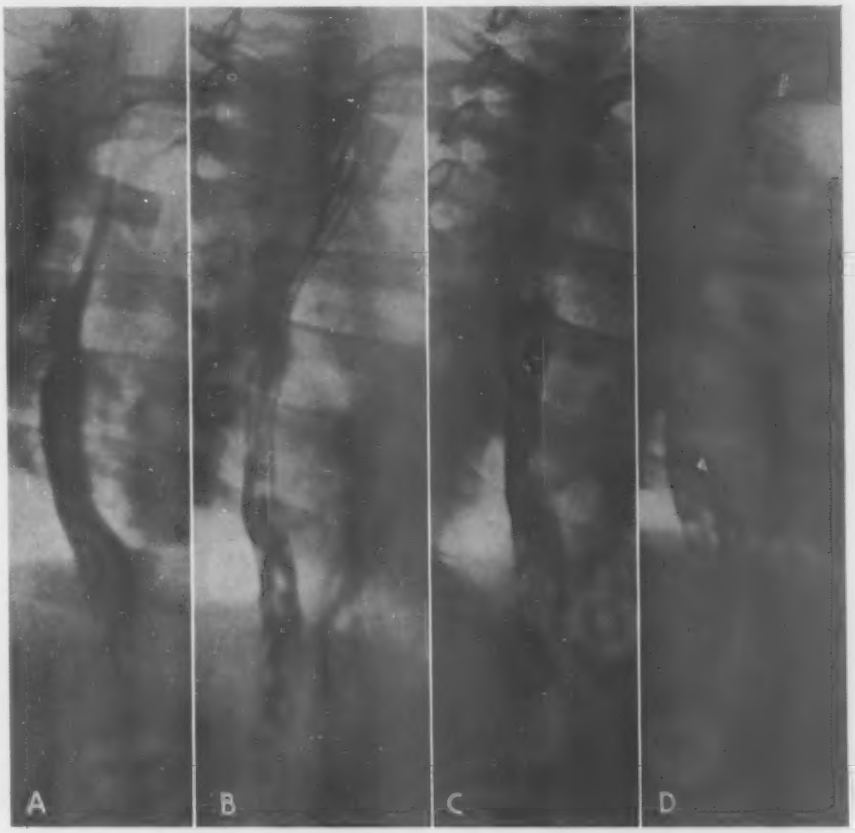

Fig. 4. Progression of varicosis shown by films taken of one patient at monthly intervals. *A*, taken in January, 1936; *D*, taken in April, 1936.

b. Roentgenographic. Owing to physiological mechanisms described below, esophageal varices are generally not visible during massive filling, but are easily demonstrated by the "thin layer" method used for examinations of the mucosal relief. During the few seconds of rest before stripping, this technique shows the barium residues as three fine, longitudinal, paral-

lel lines separated by empty spaces 3–4 mm. in width. The latter correspond to the rugae, the former to the furrows between them. While the shadow lines present an approximately equal breadth throughout the tube, the spaces or negative shadows representing the rugae are narrower in the cervical part, and slightly broader in both the upper thoracic and the short subdiaphragmatic portion, but of uniform caliber in the main part which extends from the aortic depression to the esophageal hiatus.

In typical cases, an esophageal varix appears in this method as a vermiform negative shadow about 1–2 cm. by 0.2–0.4 cm. The uniform longitudinal lines are interrupted or displaced by these formations.

Nevertheless, the roentgenological aspect is, in fact, exceedingly variable, because size, shape, number, localization and extent of the varices depend entirely upon the stage of the disease.

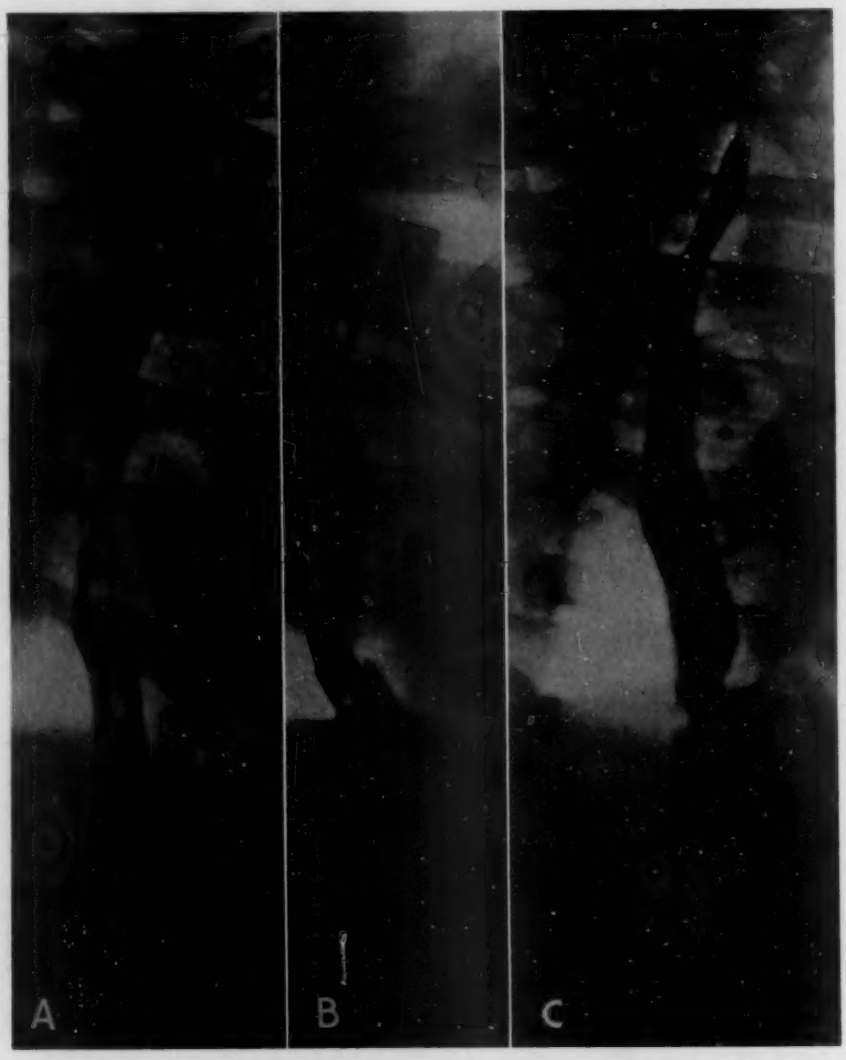

FIG. 5. The same case as shown in Figure 4. *A*, taken in a position of rest; *B*, during stripping; *C*, after second swallowing. In *B* and *C* the massive bolus and in *B* the contraction of the upper portion make the varices appear smaller and less numerous.

The first manifestation of the disease consists only in a slight broadening of the rugae in the lowest portion. This corresponds obviously to a more diffuse venous congestion which has not yet produced distention of larger individual veins. The vermiform defects, therefore, are not visible in early stages. One would hesitate to attribute special importance to this indefinite finding if it were not confirmed or more clearly defined on subsequent examinations a few weeks later.

As soon as one or more veins enlarge definitely, the tops of the varices protrude slightly from the submucosa into the mucosa, thus producing negative shadows of the size of a grain of rice to a lentil. These defects, which are seen only in the lower portion, are identical in appearance with those small swallowed air bubbles found in almost every normal tube. It is necessary, therefore, to confirm the persistence of the defects by repeated examinations, at various angles and in different phases of respiration.

With the progress of the disease the de-

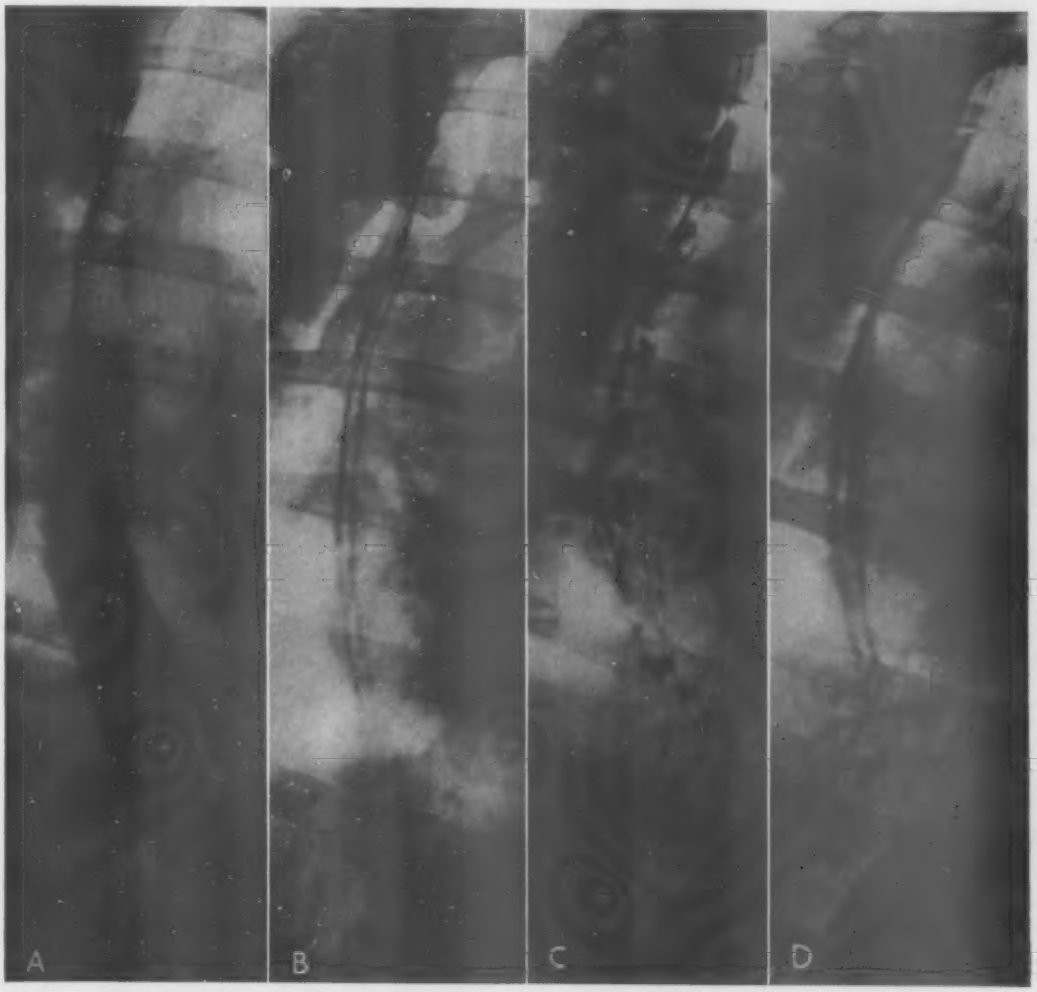

Fig. 6. Films taken at intervals of about forty-five seconds. *A* shows massive filling; *B*, total contraction due to stripping; *C*, position of rest; *D*, second stripping. Note the entire disappearance of the extensive varices in *A*, *B* and *D*, and their clear demonstration in *C*.

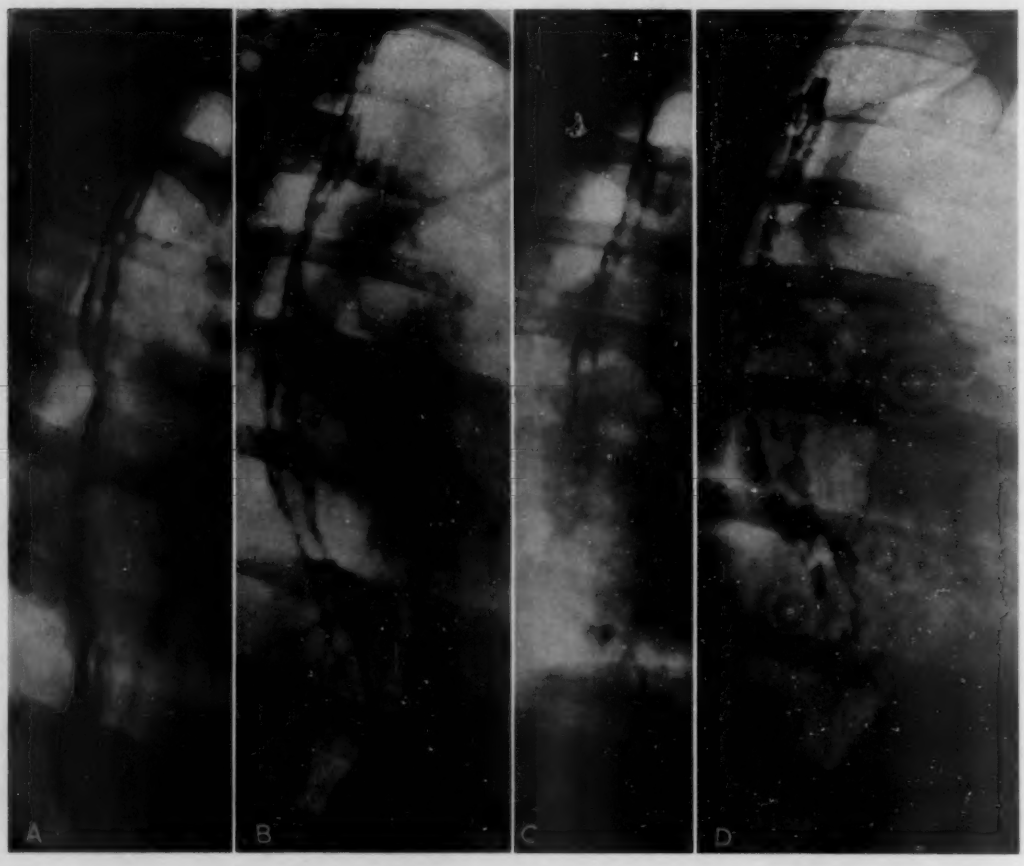

Fig. 7. Progress of the disease shown by films taken at longer intervals. *A*, October, 1934; *B*, November, 1935; *C*, December, 1935; *D*, March, 1936.

fects enlarge, but the typical vermiform shape becomes definite only after a considerable time has elapsed. During this period, which may be anywhere from three to ten months, the varicose veins encroach upon the mucosa in the lower part of the tube. Gradually the rounded negative shadows change in appearance as well as in size. Generally the characteristic vermiform defects predominate when an area larger than a fifth of the esophagus has been involved. Lenticular defects seen during this period correspond to cross-sections of varices, as may be shown by serial examinations at different angles.

The first manifestation of varicosis is invariably found at the lower end of the tube. With the progressive congestion, the varices slowly spread upward. In advanced stages, the whole thoracic esophagus is found to be involved. The cervical portion above it remains free even in excessive varicosis. In the terminal stages of 2 cases, I have observed considerable dilatation of the lower half of the tube. The opaque fluid had accumulated in the lower esophagus and overshadowed the mucosal relief. Dilated veins, however, were seen as defects at the lateral walls of the esophageal shadow. The roentgenological diagnosis, in one case, was confirmed by autopsy. It is interesting to note that in both cases the cardia remained closed for more than three hours.

PHYSIOLOGICAL FACTORS ALTERING THE ASPECT OF VARICES

Physiologically, the thoracic veins are distended on deep inspiration. When comparing films taken in different phases of

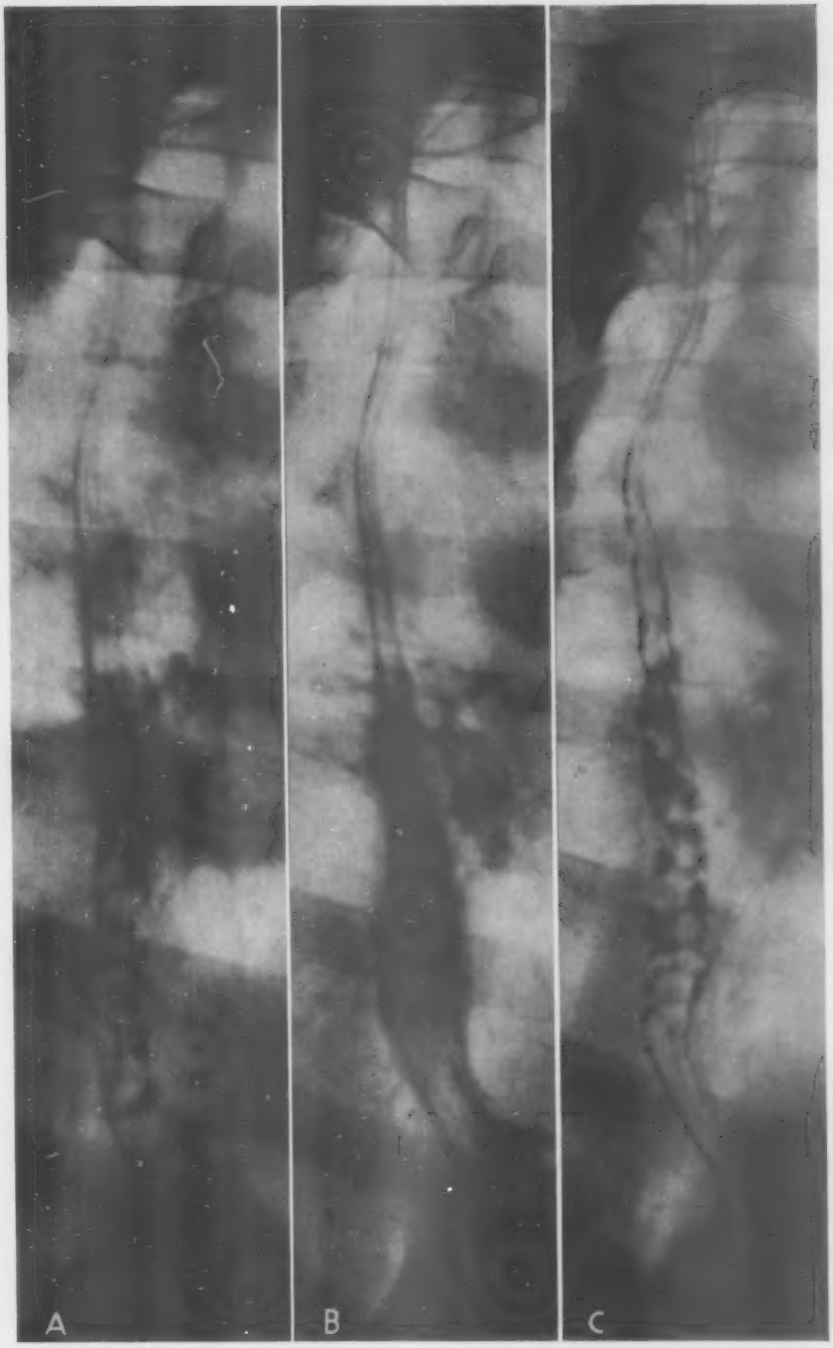

Fig. 8. Films taken at intervals of a few minutes, showing the changes due to peristalsis in *A* and *B*, and the position of rest in *C*.

respiration, a similar enlargement of the varicose esophageal veins is evident. These changes in caliber, however, are rather insignificant as compared with the marked alterations which are produced by peristaltic activity.

In the early stages as a rule, peristalsis, both wave-shaped and stripping, is still

able to constrict the esophagus to such an extent that small varices are completely emptied during contraction. In more advanced cases, stripping gradually empties the contents of upper varices into the lumen of lower ones. Thus the upper varices may appear absent on films taken during this movement, while the lower ones

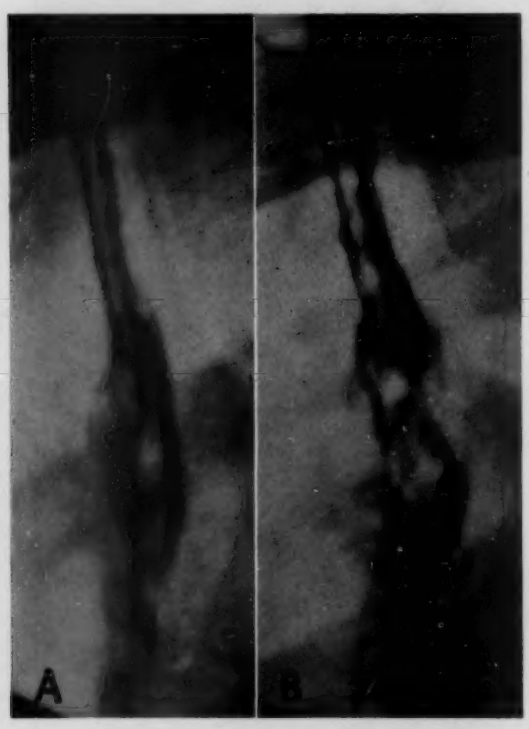

Fig. 9. Polygrams of the same portion of the esophagus. *A*, during stripping; *B*, in the position of rest. Note that the varices in the upper sector of *B* have disappeared on *A* because of the contraction.

appear larger than in the resting position. The enlargement, however, may be made invisible by the size and density of an overshadowing opaque bolus pushed towards the cardia during contraction. In these cases the true caliber and extent of the varices become evident on another film taken during the period of rest. Comparison of the two views clearly demonstrates how considerable are the changes which esophageal varices may undergo within a few seconds.

The size of the individual bolus, as already mentioned, is one of the factors which control the strength and the rate of peristalsis. Responding to the stimulation produced by a large bolus, strong peristalsis is likely to accentuate, in early esophageal varicosis, the emptying of dilated veins even into the abdominal vessels. Such a bolus also contributes mechanically to the emptying of the veins. The mechanical compression caused by its passage flattens out the veins, with the result that their caliber is so decreased that they disappear from the roentgenological picture.

It is essential, therefore, that only small amounts of the opaque mixture be used for this examination, since a large bolus may make it impossible to obtain a positive finding.

PATHOLOGICAL PHYSIOLOGY

Retardation of the passage of food through the esophagus is not a sign pathognomonic of any special disease. Mechanical obstruction, spasms of the tube or the cardia, achalasia, Holzknecht's atony of the esophagus, lesions of the vagus (Assmann), unknown factors in old age (Oppenheimer), will regularly or frequently cause esophageal stasis. As mentioned above, retardation is produced mechanically in the moderately advanced stages of varicosis, but, in both the early and the terminal stages, is due to functional disturbances. The result of this disturbance appears as a delay in the opening of the cardia, but the mechanism producing it escapes roentgen observation. As the muscular layer of the tube is found normal or even slightly hypertrophied at autopsy, the delay in passage cannot be attributed to enfeeblement of the muscles. Roentgen examinations, however, show that peristalsis decreases gradually in the course of the disease. The discrepancy between these findings may be due to various factors. One might consider, first, the possibility of a reflex disturbance which is produced either by a diminished sensibility of the mucosa due to chronic congestion, or by loss of tonicity of the muscularis which does not necessarily present anatomical

findings. Secondly, the constant mechanical irritation and the bulging varicose mass, both of which increase during swallowing, might cause a true cardiospasm. Thirdly, it should be borne in mind that the cardia is a sphincter of very variable strength in different persons, as shown, for example, by the marked difference which makes vomiting quite easy for some people, but exceedingly difficult for others. In varicosis, therefore, the mechanism of esophageal stasis may depend also to some extent upon the strength of the cardia.

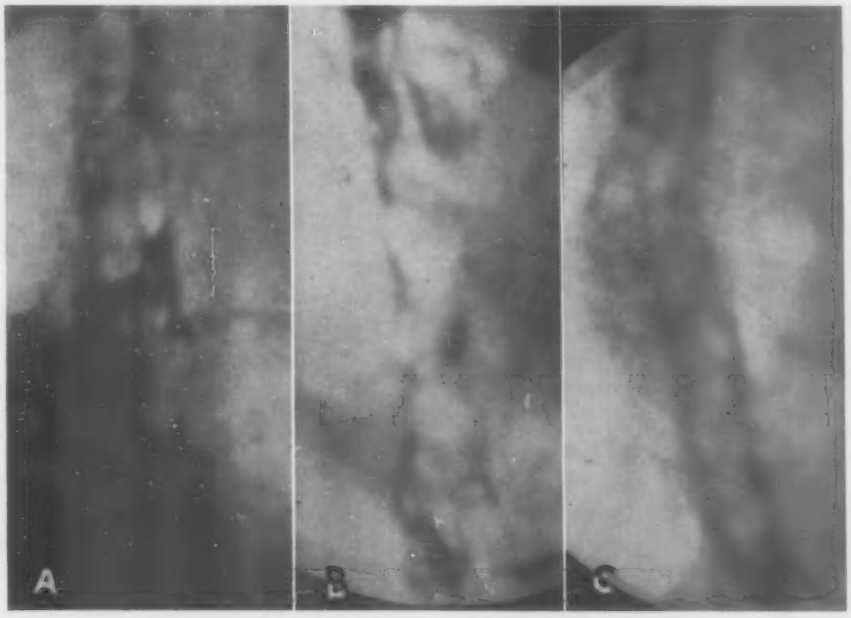

Fig. 10. Polygrams at different angles showing very marked esophageal varices.

It is possible for these three mechanisms to combine or alternate even in the same person.

CLINICAL RELATIONS

It is not the purpose of this paper to discuss the relation between clinical findings and the degree of varicosis, as this will be treated at length in a later publication. Two points, however, are worth mentioning. First, the extent and the size of varices as seen roentgenologically are not in proportion to esophageal symptoms as experienced by the patient. For example, excessive varicosis may not produce, during long periods, any hemorrhage or interference with swallowing, while comparatively small varices may cause profuse bleeding or marked discomfort. During long periods of clinical remission, for instance, the expansion of varices often steadily progresses even in the absence of symptoms. Secondly, it is important to realize that patients who show the usual clinical manifestations of hepatic cirrhosis may, under roentgenological examination, present none of the changes suggesting varices. Those, on the other hand, who are found on roentgen examination to have definite varices do not necessarily show typical clinical signs of hepatic disease.

It is obvious, therefore, that positive roentgenological findings prove (although, of course, negative findings do not disprove) the presence of one of that group of diseases classified as hepatic cirrhosis.

The present observations confirm once more the experience that the examination of the mucosal relief permits the detection of small anatomical lesions that often escape any other clinical method. This technique naturally emphasizes concentration on anatomical details, i.e. on "direct roentgen signs." Nevertheless, greater

weight seems to be given to both the diagnostic usefulness and the scientific accuracy of the thin layer method by correlating these anatomical findings with all the functional effects which are visible roentgenologically. Roentgenology, after all, is not synonymous with anatomy.

SUMMARY AND CONCLUSIONS

1. The roentgenological appearance of esophageal varices is the product of two variable factors: (*a*) the anatomical formation, (*b*) the actual physiological condition during exposure.

2. Anatomically, the roentgen findings vary greatly with the stage of the disease. Three groups stand out: (*a*) the early stage, marked by a slight and diffuse venous congestion resulting in moderate broadening of the rugae of the lower esophagus; (*b*) the beginning of the dilatation of larger individual veins which emerge from the submucosa into the mucosal relief. This stage is marked by small rounded defects seen in the relief of the lower fifth of the tube; (*c*) generalized enlargement of numerous veins which encroach upon the mucosa. In this period, the typical vermiform negative shadows predominate.

3. Varices, not being solid anatomical formations, vary in caliber according to influences acting upon their filling. Definite variations in size and extent are produced by peristalsis, especially stripping, and by mechanical pressure—that, for example, of a large bolus. In either case, blood is moved into lower vessels. In early portal congestion, the blood can still pass into abdominal veins. Later it is squeezed from upper varices into lower ones, overfilling the latter.

4. This mechanism, in early stages, makes esophageal varices invisible and, in advanced stages, makes visible only a part of the whole extent. Roentgen examination generally does no more than confirm the clinical diagnosis in advanced stages, while in early congestion the clinical recognition often depends on positive roentgen findings only. It is necessary, therefore, to demonstrate the mucosal relief of the esophagus when unaltered by peristalsis or mechanical compression. Technically speaking, optimal visualization is present during the short interval between swallowing and stripping.

5. As a part of the thoracic veins, esophageal varices fill on inspiration. Hence it is advisable to expose the film during forced inspiration.

6. The retardation of the passage through the esophagus, a common finding in varicosis, varies between a few seconds, in early congestion, and several hours, in terminal stages. It is often due only to mechanical obstruction by the varicose mass. But, in very early and in terminal stages, various functional disturbances affecting the cardia also cause esophageal stasis.

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ROENTGEN DIAGNOSIS AND THERAPY OF SYRINGOMYELIA*

By E. B. GUREVITCH, G. B. FOMIN, *and* P. B. SHKLOVSKAIA
MOSCOW, U.S.S.R.

NOTWITHSTANDING the fact that the trophic disturbance of the bones and joints appears as a cardinal symptom in syringomyelia, the literature calls attention to only a small percentage of osteoarthropathies (Borchard 10–25 per cent, Osinskaia 32 per cent), although, a priori, one should expect a very high percentage since syringomyelia, which, while predominantly attacking the serous membranes, spreads so rapidly in all directions that the trophic centers must likewise suffer. This condition, in our opinion, arises from the fact that the cases of syringomyelia are insufficiently studied and followed up in the field of skeletal structure. In fact, since 1932, following the outline of Professor Dilloh, in a systematic follow up of the upper skeleton of all syringomyelia cases prepared for roentgen therapy, we have discovered in 94 cases out of a total of 128, 73 per cent of trophic disturbances of the bones and joints.

Contrary to most authors who report a predominant involvement of the elbow joint, then the shoulder and wrist (Ivanov, Strumpell, Reinberg, and others), we note the most frequent involvement of the phalanges and their joints in 71 cases, or 75 per cent; involvement of the wrist in 6 cases, or 6.5 per cent; of the elbow joint in 14 cases, or 15 per cent; of the shoulder in 3 cases, or 3.5 per cent.

Osinskaia, in 26 cases of 43 studied, had observed a high incidence of involvement of the metacarpals and phalanges, something like 64 per cent. An analysis of the skeletal changes discovered in our cases enables us to present the following roentgen findings in syringomyelitic osteoarthropathies.

In the involvement of the bones both productive and destructive changes take place. The productive changes can be only minimal and express themselves in a mushroom-like spreading, or sharpened edges of the distal phalanges (Fig. 1). The destructive changes assume many different characters. In some cases, while there is a relatively insignificant change in the distal phalanx and the formation of a sequestrum (Fig. 2), there may appear va-

TABLE I

SKELETAL CHANGES FOUND IN 94 PATIENTS AS RELATED TO BONES AND JOINTS

	Number	Per Cent
Overgrowth of distal phalanges	23	24.4
Destructive changes of distal phalanges	6	6.4
Amputation of distal phalanges and second phalanges	15	16.0
Deformities of phalangeal joints	12	12.8
Subluxations of phalanges	6	6.4
Thinning, atrophy and osteoporosity of wrist bones	9	9.6
Some bony overgrowth in wrist joint	2	2.1
Rarefaction deformities of the bones of radius and radio-metacarpal joint	4	4.2
Periarticular deposits in elbow joints	2	2.1
Rarefaction deformity in elbow joints	9	9.6
Rarefaction deformity in shoulder joint	3	3.2
Fractures with overgrowths	3	3.2
	94	

* From the Roentgen Department of Professors L. G. Dilloh and S. G. Levit. Translated from the Russian by David B. Gaberman, M.D., Detroit, Michigan.

FIG. 1. Small overgrowths at edges of distal phalanges.

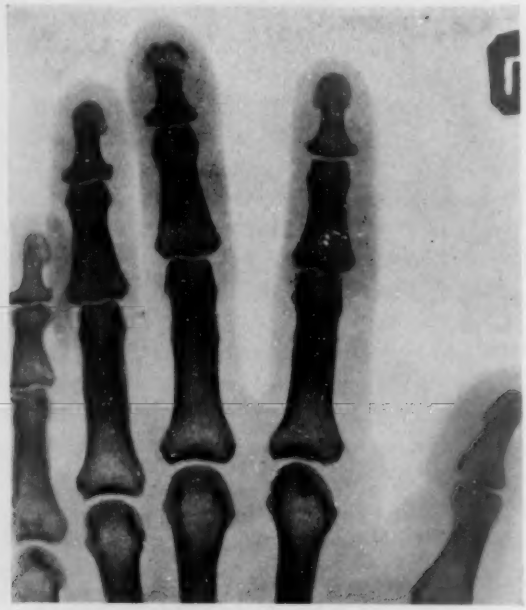

FIG. 2. Destruction of head of distal phalanx, with formation of sequestrum.

rious degrees of spontaneous amputations involving only a small part of the bone. In other cases, a half of a phalanx separates and in some cases an entire phalanx, or even all the phalanges of a finger may be spontaneously amputated (Figs. 3 and 4), or there is a destruction of a whole row of bones of the wrist (Fig. 5). Occasionally in

Fig. 3. Spontaneous amputation of distal phalanges of the fingers.

FIG. 4. Amputation of all phalanges of second finger.

Fig. 5. Destruction of carpal bones and ankylosis of first metacarpophalangeal joint of thumb.

the same patient one may find many different forms of involvement from a small overgrowth to an amputation of a whole

Fig. 7. Destruction of articular surfaces of first metacarpophalangeal joint, with dislocation of proximal phalanx on metacarpal head.

Fig. 6. Spreading of edges of distal phalanx, amputation of phalanx and deformity and thickening of the phalangeal joint.

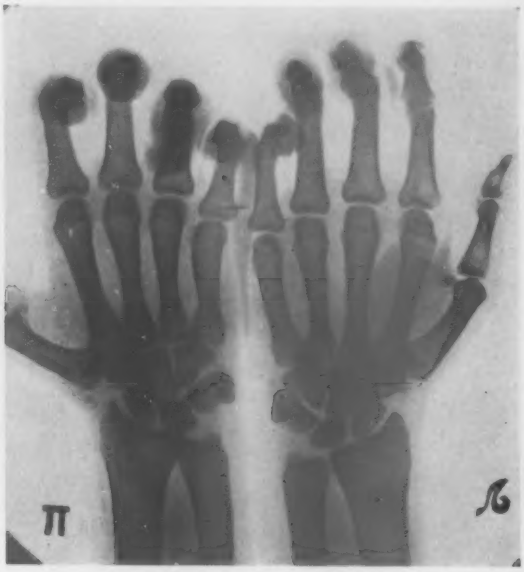

Fig. 8. Contracture of distal and middle phalanges.

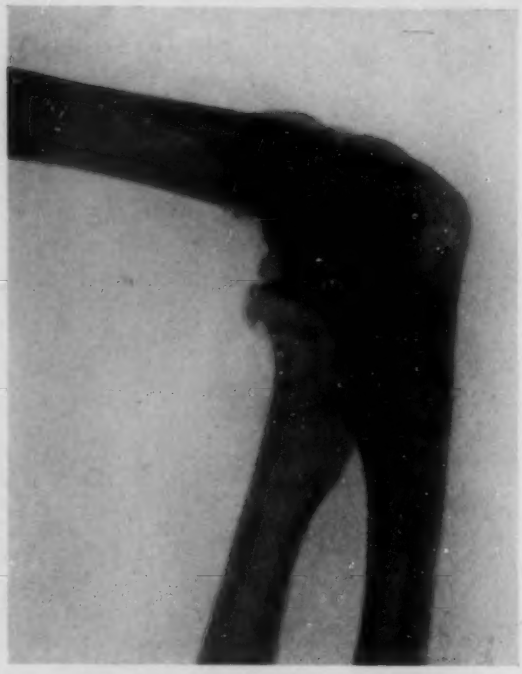

FIG. 9. Small amount of spreading of edges of joints of radial head.

phalanx (Fig. 6). Along with bony involvement there is also considerable change in the phalangeal joint spaces, characterized more or less by their deformities, notably thickening of the joint ends (Fig. 6). Interphalangeal spaces appear oblique, the fingers are bent and deviated to the side; dislocations and subluxations appear (Fig. 7). In isolated cases, contractures take place (Fig. 8), and sometimes a real ankylosis ensues (Fig. 5). Sometimes one sees partial destruction of the articular ends of the bones or a more or less marked tapering of these bones (Fig. 7).

FIG. 10. Periarticular deposits and thickening of joint surfaces.

FIG. 11. Deformities and destruction of articular surfaces, with partial preservation of joint space.

The changes in the case of the larger joints can be but minimal and may be seen only as small deposits at the articular ends of the bones (Fig. 9). In the more severe cases the overgrowth of the edges of these bones appear "moth eaten" and are accompanied by numerous periarticular deposits with a flattening of the articular parts of the bones (Fig. 10). And, further, there can ensue a destruction with resulting deformity of all the ends of the bones in a given joint with occasionally a joint space being spared (Fig. 11), or a marked sep-

aration of the bone ends in the joint (Fig. 12). The destruction of these parts is often accompanied by massive deposits of calcium about the joint (Fig. 13). The periarticular deposits not infrequently assume a semblance of bony structure (Fig. 14).

Because of the brittleness of the bones in syringomyelia, frequently fractures are

Fig. 12. Destruction and considerable separation of articular surfaces of joint.

sustained from such insignificant trauma as to escape the notice of the patient. These fractures are usually transverse without much, if any, splintering. Callus proliferates very rapidly, is irregular in outline, either scattered here and there or symmetrically encircling the area of fracture, assuming a spindle-shaped form of clear structure and sharp outline which

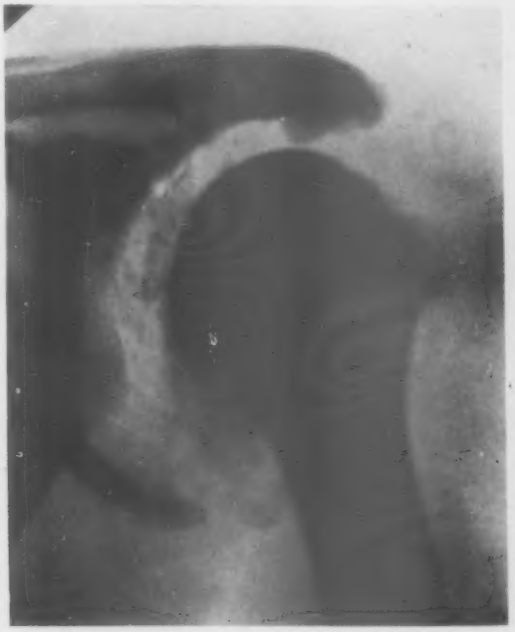

Fig. 13. Destruction of articular surfaces of the bones, with massive deposits of calcium around joint.

Fig. 14. Destruction of articular surfaces, with deposits of calcium around joint. Fracture of ulna with formation of large spindle-shaped callus.

FIG. 15. This patient, in spite of considerable destruction and distortion at the wrist, was able to carry on her work as a laundress without much or any pain. Complete destruction of all carpal bones, with dislocation of radio-ulnar-carpal joints.

extends much beyond the bounds of the fracture (Fig. 14).

It is important to remember that despite the destruction of either bones or joints, the function is maintained. As an example we cite the case of a patient suffering for thirteen years, who has almost a complete destruction of the wrist joint with dislocation, and in spite of that can quite satisfactorily do her work as a laundress using this extremity (Fig. 15). In 20 per cent of the cases we noticed simultaneous involvement of both the small and large joints.

DIFFERENTIAL DIAGNOSIS

The marked similarity in the roentgen appearance of syringomyelitic arthropathies and tabetic disturbances makes the diagnosis more difficult. The difference, however, consists in the location of the disease. Tabes involves the lower half of the body in about 80 per cent of the cases, whereas syringomyelia involves the upper half of the body in the same percentage (Schlesinger, Rotter and Budinger).

Syringomyelia is more often a unilateral disease (Oelicker). In occasional cases the picture of syringomyelitic osteoarthropathy resembles the changes seen in osteoarthrosis. According to Hildebrand the differences are: destructive signs in deforming osteoarthrosis occur but seldom, while the productive changes in the joint cartilage are very marked. In syringomyelitic osteoarthropathies the extra-articular bony spreading is very common. In osteoarthrosis one never sees intracapsular (intrajoint) fractures so often met with in syringomyelia.

Of significance is the great difference in the clinical course of these diseases. In syringomyelia the subjective symptoms may be very mild compared to the roentgen findings, and the function of the extremity is usually good despite the profound anatomical changes. In the case of the shoulder joint the picture may remind one of dry tuberculous caries. In the latter, however, there are usually no associated peri- or para-articular changes and there is a characteristic clinical picture, such as pain and contractures, whereas in syringomyelia there is swelling, and spreading of the joint which is almost painless. The changes and roentgen defects in tuberculosis do not help to differentiate them from syringomyelia since the latter disease can produce them (Esau).

Involvement of the phalanges must be differentiated from eczema (itching) eruptions, from diseases of the nerves, Reynaud's disease, angioneurotic disturbances, trophic and destructive diseases of the finger. Here the clinical history is of aid in arriving at a differential diagnosis.

The appearance of osteoarthropathy in syringomyelia, according to most authors,

is to be explained by the vasomotor disturbances which lead to impaired nutrition of the bones and the joints. Early changes in some bones and joints and great destruction in others may coexist. For illustration we cite the following case:

A painter, aged forty. Ill for two years. Roentgen findings characteristic of syringomyelia. Small mushroom-like overgrowth on the tubercles of the distal phalanges. Moderate deformity of the wrist joint and dislocation of the left thumb, and at the same time a most extensive destruction of the shoulder joint (Fig. 16).

From the foregoing it follows that in the investigation of the bones and joints in syringomyelia, we should not limit ourselves to the investigation of one group of joints, but we should examine all the bones and joints of the upper half of the skeleton. Not infrequently several joints may simultaneously be affected by different diseases. In such cases, the investigation of one joint may not disclose the underlying pathology. Such a case occurred in our series:

A peasant woman, aged fifty-five. Ill for thirty-three years. Clinical diagnosis syringomyelia. Roentgen examination of the shoulder joint (Fig. 17) showed a typical picture of deforming osteoarthrosis. Investigation of the hands showed a well-established picture of syringomyelitic changes (Fig. 2).

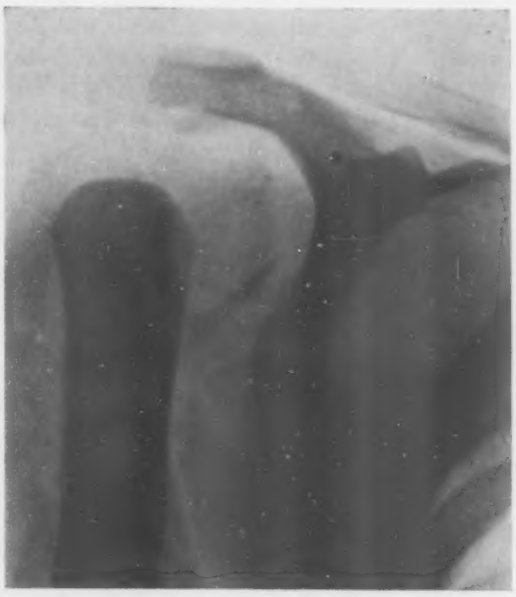

Fig. 16. Considerable destruction of shoulder joint.

Fig. 17. Deforming osteoarthrosis of shoulder joint.

The question of the duration of the disease and its relationship to bony dystrophy, according to many authors, is not settled, and very often the roentgen findings of osteoarthropathies are among the first signs of the disease (Osinskaia, Muller). In only 41 cases were we able to obtain authentic data as to the length of their illnesses and Table 11 brings out the bone and joint changes in relationship to the duration of the disease:

Conclusions drawn from these data would be unwarranted. The material is too small, and its study fails to bring out any basic principles. One can only draw the inference that osteoarthropathies occur more frequently when the disease has been

TABLE II

Bone and joint changes	Length of illness	6 mo.	1 yr.	2 yr.	3 yr.	4 yr.	5 yr.	More than 5 yr
				Number of Patients				
Minor changes	Wrist and hand	1		2	2	2	2	2
	Elbow							1
Great changes	Wrist and hand	1	1	2	3			11
	Elbow joint		2		4	1		4
Cases		2	3	4	9	3	2	18

of from three to four or more years in duration.

We cannot say how closely the bone and joint disturbances parallel the nervous system. For in cases with well-established evidence in the nervous system, roentgen evidence in the bones and joints was lacking and severe bone and joint changes were found in the presence of minimal involvement of the nervous system. In most of our cases the diagnosis was not established by the neuropathologist until roentgenograms had been made. In only one case was the patient sent to the polyclinic for a shoulder joint disease with the diagnosis by the neuropathologist. A case of this type was described by Fritch.

Conclusions. (1) Involvement of the bones and joints in syringomyelia occurs with great frequency; in our cases 73 per cent. (2) The parts most frequently attacked are the phalanges and wrist bones, then the elbow, more rarely the radius and shoulder. (3) Osteoarthropathies in syringomyelia simultaneously show both productive and destructive changes. (4) The function of the involved extremity does not parallel (inversely) the degree of anatomical changes. It can be preserved even in very severe cases. (5) The roentgen investigation has an important place in establishing the diagnosis, especially in those cases where the symptoms in the nervous system appear late. (6) In syringomyelia it is most important to carry out a systematic and complete investigation of all the bones and joints in the upper half of the skeleton.

ROENTGEN THERAPY IN SYRINGOMYELIA

Notwithstanding the fact that the clinical and pathological anatomy of syringomyelia is well worked out, its treatment has long remained without success. Neither medicinal nor physiotherapeutic agents have been of any value.

In 1905 Raymond, Oberthur, and Delherm gave a fifteen year old girl suffering from syringomyelia roentgen therapy with such profound success, that, although the patient had been ill for six years, she showed tremendous improvement. Since then the roentgen ray has been used a great deal in the treatment of this disease. Many authors have since reported their success with roentgen therapy. Gramen, in 1906, called attention to great improvement in motion and nutrition. Bonzoni reports one case. Beaujard and Lehrmitte, in 1907, 3 cases. Holmgren and Wiman, in 1908, one case. Labeau, from Bergon's clinic, 6 cases with remarkable improvement in 4. Nobelle, in 1909, one case. In 1909, at the congress in Milan, Raymond, Oberthur and Delherm completed their observations on their first case in 1905 and reported that the improvement had re-

mained permanent. Beaujard, in 1910, described 8 cases of syringomyelia treated successfully with roentgen therapy. Duhain, Marques, Roger, Robin, Cawadias and Wetterstrand report several successfully treated cases and state that in early cases the disease is arrested and great improvement ensues, and even in late cases great improvement in all symptoms may be expected.

Osinskaia and Gize at the Third Congress of Roentgenologists in 1925 reported 14 treated cases, with significant improvement in a very large percentage. Sharapow, in a series of 14 cases, drew similar conclusions. In 1926, Wielski and Antwinski described 2 successfully treated cases. In 1927, Störmer and Bremer described 9 cases treated, with marked improvement in 3, slight improvement in 3 and in 3 others there was no change. In 1926, Kayser reported 53 cases of syringomyelia treated with deep roentgen therapy with considerable improvement in 60 per cent. Proust, Mallet and Coliez, in the same year, reported good results in 4 cases. Coliez and Rebuffel also described one successfully treated case.

Heinesman and Tzerni, in 1929, evaluated roentgen therapy in 70 patients observed from one to five years and obtained the following result: in 70 per cent of the cases there was great improvement; in 13 per cent the process was apparently arrested; in 12 per cent the symptoms continued to progress. Gize and Osinskaia (in 1929), in analyzing 83 cases, report remarkable improvements in the most important symptoms in 50 per cent, in 20 per cent the disease progressed and in the remaining cases the disease appeared arrested.

In 1930, Kolin and Businov described 24 cases of syringomyelia treated with roentgen rays and reported from 40–50 per cent of the cases considerably improved. In 1930, Delherm, Morel-Kahn and Desgres treated 15 patients, with good results in 9, or 60 per cent; progression of the disease was noted in 33 per cent and no change in 7 per cent. Our material comprises 388 patients with syringomyelia. According to their age groups:

Up to 20	47	or	12%
Up to 30	156	or	40%
Up to 40	100	or	25.8%
Up to 50	64	or	16.2%
Up to 60	21	or	5.5%
Total	388		

According to sex:

Males 252 or 64%
Females 136 or 36%

TECHNIQUE OF TREATMENT

The factors used in the roentgen therapy of syringomyelia are: 185 kv., 4 ma., filter 0.5 Zn plus 3.0 Al; field 8×15 cm. Therapy is administered locally to the involved area of the spinal cord and spinal column. Over each field, 50 per cent of the skin erythma dose. The course is repeated in one month. The following series are given in accordance with the duration of the disease with intervals not greater than three to four seances in two months and four, five or six seances in three months.

Since 1931, on the basis of our own observations and those of Stoppani, that improvement may appear only after five or six seances, we have changed our technique somewhat by increasing the number of seances, to seven or eight and giving them at monthly intervals. In agreement with the cases cited in the literature that the localization of the anatomic changes does not always correspond to the clinicical findings, we have enlarged our fields both upward and downward from the location of the affected area.

It was possible to evaluate the therapeutic results in only 137 cases which according to the duration of their illnesses fall into the following:

	Cases
Up to 6 months	14
Up to 1 year	22
Up to 2 years	23
Up to 3 years	19
Up to 4 years	14
Up to 5 years	11
More than 5 years	34
Total	137

Without going into the details of the clinical picture of our patients, we can say that in all cases the disease was well established symptomatically, varying in different degrees in the fields of sensory, motor and trophic disturbances. Passing to the results we obtained through the use of roentgen irradiation, we can note the following: Complete improvement was shown in 94 cases, or 68.6 per cent; without change, 42, or 30.6 per cent; 1 case grew worse. According to the improvement in symptoms the following was noted:

	Cases
Sensory improvement	43
Increased muscle power	33
Disappearance of pains	22
Improvement in motor function	28
Diminution of paresthesia	6
Diminution of atrophy	1

In the great majority of the cases we were able to note subjective improvement. Among the objective symptoms, first of all there was return in sensation of pain, later on, thermal sense, although it was not infrequently noted that the first improvement was in the motor disturbances. The return of motor function and muscle strength is of great value in that it makes the patient able to return to his occupation, frequently doing heavy physical labor. For illustration we cite a case from our material.

Female, aged forty-five; ill for three years. Complained of pain in the right shoulder and hand. Objective data: right-sided scoliosis of thoracic spine, weakness in right hand, atrophy of the little muscles of the hand. Dissociated disturbance of sensation. After two series of roentgen therapy with an interval of one month between them, there was a marked improvement in the entire condition; the limits of the fields of sensory disturbance became narrowed, pains in hand disappeared, muscular strength improved so that she returned to her former work, that of milking cows.

As in the case of many other authors, we too note the lack of effect of roentgen therapy on muscle atrophy. As will be seen from the following table, maximum improvement was noted after two or three seances, less after one to four.

TABLE III

RELATION OF THERAPEUTIC RESULTS TO NUMBER OF IRRADIATIONS

Number of irradiations	1	2	3	4	5	6	94%
Number of patients	19	21	22	14	4	14	
Percentage	20	22.3	23.4	15	4.3	15	100%

Our data oppose the opinion of Gize and Osinskaia in that we feel that if no improvement follows the first treatment little may be expected thereafter. The relation of the efficacy of the treatment to the duration of the disease is, according to most authors, as follows: the earlier the case, the better the result, although cases of ten or more years' duration have been reported as successfully treated.

Our own cases successfully treated and presented according to the duration of the disease reveal the results shown in Table IV.

Among the 21 listed as ill more than five years were patients ill from ten to fifteen years or more. Two of these cases were as follows:

Female, aged fifty-five, ill thirty-three years. After awhile there appeared pain and limitation of motion in the left hand. Gradually there ensued a spreading weakness and loss of sensation; in the right hand and leg. Since the spring of 1932 a numbness in the toes of the left foot. Objectively: the movements and strength of the upper extremities were diminished. Decrease of pain and temperature sensation; increased knee jerks. After two exposures the general condition was markedly improved. The motion of the left hand returned to almost normal. The muscular strength increased.

TABLE IV

Duration of illness	6 mo.	1 yr.	2 yr.	3 yr.	4 yr.	5 yr.	More than 5 yr.	Total
Number of patients	13	17	17	12	9	5	21	94 cases
Percentage of patients	14	18	18	12.7	9.6	5.4	22.3	100%

Patient, aged forty-one, ill sixteen years. Pains in the left chest and the left hand; numbness and weakness. Left rotary nystagmus; tremor of the tongue. Disturbance of sensation on the left half of the body. Tendon reflexes heightened. Arthropathy of the left elbow joint. After two exposures an improvement in the general condition. The area of sensory disturbance was halved. From our material we note that the greatest improvement was seen in cases ill from three to four years.

We did not succeed in confirming the belief of many authors (Heinesman, Tzerni, Kolin and Rusinov) that the patient of advanced age is refractory to treatment in that, in our series, there were several patients between fifty and sixty years of age, who nevertheless showed good results following irradiation. One such case we have cited. We observed the length of improvement from one to five years.

As to the "modus operandi" of roentgen therapy in syringomyelia, we share the opinion of most of the authors who consider the effect of roentgen therapy as a result of direct attack on the glial hyperplasia. That with the diminution of glial structure the nerve tissue is released from pressure.

And, finally, we cannot pass one very important point. Several authors attribute the improvements in syringomyelia patients treated with deep therapy to spontaneous remissions, which are characteristic in such a long standing chronic disease as syringomyelia. Without denying the possibility of a remission we can show that with this therapy not only is the process arrested, but its return was not noted for a period of ten years (Merrill), and in some cases even twenty years (Menetrier and Dervil). The constant progress of the disease up to the time of treatment, and the histologic findings (Lhermitte) force us to conclude that the improvement was due not to a remission but rather to the specific effect of roentgen therapy. From this we see that roentgen therapy in syringomyelia appears as a method of choice which in the majority of instances affords very good results.

In the light of the foregoing, one cannot understand the statement made by Ivanov in 1923 that deep therapy in syringomyelia was forgotten because it reached that point of effectiveness reached by all other methods. Although this might be explained by the fact that up to 1923 there was still an insufficient number of successfully treated cases on record (from looking over the literature we cannot reach such a conclusion), it is still harder to understand why in Russian texts on diseases of the nervous system there is either no mention made about roentgen therapy in syringomyelia (Sacharchenko, 1930) or just a few words devoted to it (Astvazaturov), while at the same time the number of patients successfully treated is increasing constantly.

According to most of the authors the therapeutic value of roentgen irradiation in syringomyelia is a well-established fact.

CONCLUSIONS

1. Roentgen therapy in the treatment of syringomyelia appears to be the method of choice.

2. The response to roentgen therapy does not depend on the age of the patient, the duration or severity of the disease.

3. Only deep roentgen therapy is of value.

4. Lack of therapeutic response after one or two treatments should not deter us, in that good results may occur after six or eight treatments.

5. Roentgen therapy, properly carried out, not infrequently enables the patient to return to his usual labor.

We wish to express our gratitude to Professor Dilloh for arranging the subject matter and his help in dealing with it.

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EXPERIMENTAL STUDIES ON GASTRIC PHYSIOLOGY IN MAN

III. A STUDY OF PYLORIC CONTROL. THE RÔLE OF MILK AND CREAM IN THE NORMAL AND IN SUBJECTS WITH QUIESCENT DUODENAL ULCER*

By J. GERSHON-COHEN,† M.D., and HARRY SHAY, M.D.

WE HAVE recently recorded the effect of acids and alkalis on the pyloric action in man.[25] This report represents similar investigations made with milk and cream and includes studies in subjects with quiescent duodenal ulcer as well as in normal individuals. The ulcer subject was included because of the rôle these two foods play in the usual ulcer regimen.

EXPERIMENTAL METHODS

The subjects, before being accepted for the normal group, were very carefully studied to rule out any pathological or abnormal functional condition. Psychic disturbances were avoided as much as possible by repeated intubation and roentgenoscopic examinations. All drugs were prohibited during the period of study. The evening being the best available time for examination, the following routine was employed: The subject was permitted to eat his usual lunch at noon, and at 3 P.M. to take two slices of dry toast and a cup of tea *without cream*. Nothing was taken thereafter until 8 P.M. when the studies were begun.

The standard water-barium meal consisted of 250 c.c. of water at body temperature containing 2 ounces of barium sulphate. The volume of all our test meals remained the same. The gastric emptying time for each subject was first established with the standard water barium meal and checked at least twice again: once before proceeding with further determinations, and once after the experiments with the test substances were concluded. Many of the subjects had as many as five or six determinations of gastric evacuation with the standard water-barium meal. Under the conditions outlined very little variation in gastric emptying was found in the same individual with similar test meals. The gastric residues were examined both roentgenoscopically and roentgenographically and *frequently checked by the removal of the contents from the stomach with a stomach tube*. After 5, 15, 30, 60, 90, and 120 minutes (and sometimes longer), roentgenograms were made of the entire abdomen. These were made with vertical rays, the patient usually in the prone position, rarely supine and always after roentgenoscopic observations lasting intermittently for several minutes. The patient was allowed up and about between examinations.

Next, from 15 to 120 minutes after duodenal intubation, gastric emptying was determined (using the water-barium mouth meal again) in order to determine the mechanical effect of the tube. With these results at hand, each subject was reintubated with a duodenal tube, the tip coming to rest in the second or third segment of the duodenum. The test substance, again the same grade of milk or cream, was slowly instilled into the duodenum, followed in five to ten minutes by the ingestion of the standard water-barium meal. The duodenal instillation was regulated with the aid of a Murphy bulb, the rate in this series varying from 10 to 150 drops per minute. The slower rates were favored in order to avoid distention of the duodenum and this was checked roentgenographically many times by the addition of barium sulphate. The roentgen observations and records were

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† Thesis submitted to the Faculty of the Graduate School of Medicine of the University of Pennsylvania in partial fulfillment of the requirements for the degree of Doctor of Medical Science (D.Sc. (Med.)) for graduate work in radiology.

made as noted above. Not only were milk and cream thus studied, but some of their constituents as well, such as lactose and casec.* Many other studies were made, using meals with concentrations of glucose ranging from 5 to 45 per cent, normal saline and 5 per cent solutions of sodium chloride, various oils, such as cottonseed and olive oil, the higher fatty acids as exemplified by oleic acid and irritants such as pepper. These will be referred to only insofar as they help clarify the picture obtained with milk and cream. Milk, AA grade, and table cream, always from the same source, were used as the test substances in this group of experiments. The constituents were as follows:

Milk	per cent	*Cream*	per cent
Water	86.0	Water	70.35
Total solids	14.0	Fat	22.0
Fats	3.6	Protein	2.93
Proteins	3.6	Lactose	4.09
Lactose	4.85	Minerals	0.63
Minerals	4.75		
Total ash	9.2		

The normal subjects were divided into three groups: those with a normal gastric acid response, determined by fractional gastric analysis after an Ewald meal; those with achlorhydria†, and those with hyperchlorhydria. Those with quiescent duodenal ulcer were grouped apart. Each diagnosis was established as carefully as possible using all known methods. Only cases with uncomplicated quiescent ulcers were studied. There were 7 subjects in the normal group: 2 achlorhydrics, 3 with average gastric acid secretory response, and 2 hyperchlorhydrics. In addition, partial examinations were made on several other normal subjects. There were 4 patients in the duodenal ulcer group. This report is based on a total of 92 serial roentgen studies.

* Casec is milk protein.

† Achlorhydria may not be normal and we feel strongly that it signifies a very abnormal condition in spite of the fact that Bloomfield and Polland,[3] as a result of an extensive experience and exhaustive studies, conclude that achlorhydria is of no clinical significance: "The fact that every degree of secretion is found in people in general, that on the whole the rate of secretions lessens with advancing years and that the finding of anacidity increases in the higher age periods suggests that lack of acid is, as a rule, an involutional phenomenon of no special clinical significance."

EXPERIMENTAL DATA

By referring to Table I, it will be noted that the residues of milk-barium mouth meals are from 30 to 75 per cent greater

TABLE I

EFFECT OF MILK ON GASTRIC MOTILITY

Name	Gastric Acid Response	Time	Gastric Residue	
			Water	Milk
G. L.	Anacid	60 min.	0	30%
R. O.	Anacid	30 min.	15%	70%
R. A.	Normal	90 min.	10%	50%
S. C.	Normal	120 min.	0	50%
R. M.	Normal	90 min.	5%	65%
S. K.	Hyperacid	60 min.	0	75%
H. K.	Hyperacid	45 min.	0	70%

TABLE II

EFFECT OF TABLE CREAM ON GASTRIC MOTILITY

Name	Gastric Acid Response	Time	Gastric Residue	
			Water meal	Table cream
G. L.	Anacid	60 min.	0	90%
R. O.	Anacid	30 min.	15%	90%
R. A.	Normal	90 min.	10%	95%
S. C.	Normal	120 min.	0	90%
R. M.	Normal	90 min.	5%	85%
H. K.	Hyperacid	45 min.	0	90%
S. K.	Hyperacid	60 min.	0	80%

TABLE III

EFFECT OF DUODENAL INSTILLATION OF MILK ON GASTRIC MOTILITY

Name	Gastric Acid Response	Time	Drops per Minute	Gastric Residue	
				Control	Milk
G. L.	Anacid	60 min.	150	0	80%
R. O.	Anacid	30 min.	30	15%	65%
R. A.	Normal	90 min.	30	10%	95%
S. C.	Normal	120 min.	30	0	80%
R. M.	Normal	90 min.	30	5%	90%
S. K.	Hyperacid	60 min.	60	0	85%
H. K.	Hyperacid	45 min.	30	0	90%

than those of the standard water-barium meal. The residue in the anacid group was apparently no greater than in the normal or hyperacid groups. The gastric residues of cream, in all cases, were greater than those of milk (Table II). The duodenal instillation of milk, as little as 50 drops per minute, caused a marked delay in the gastric evacuation of the water-barium meal. Gastric residues of 65 to 95 per cent resulted, where previously, emptying had been complete in the same interval when no duodenal instillation was done (Table III). The results of similar studies with cream are tabulated in Table IV. The gastric delay is so much greater with cream that as little as 6 to 9 drops per minute instilled into the duodenum can result in a 90 per cent retention. Tables V, VI, VII, and VIII show the results of the same experiments on subjects with quiescent duodenal ulcers. The effects on those were essentially like those in normal subjects. Although the tables quickly reveal the effect on gastric evacuation of both milk and cream when applied to either side of the pylorus, a detailed account of the roentgenoscopic and roentgenographic records is necessary before the effect on gastrointestinal tone, peristalsis and py-

TABLE IV

EFFECT OF DUODENAL INSTILLATION OF TABLE CREAM ON GASTRIC MOTILITY

Name	Gastric Acid Response	Time	Drops per Minute	Gastric Residue	
				Control	Cream
G. L.	Acid	60 min.	60	0	100%
R. O.	Anacid	30 min.	30	15%	100%
R. E.	Anacid	30 min.	10	15%	70%
R. A.	Normal	90 min.	6–9	10%	90%
S. C.	Normal	120 min.	20–30	0	90%
R. M.	Normal	90 min.	30	5%	90%
M. K.	Hyperacid	45 min.	30	0	100%
S. K.	Hyperacid	60 min.	25–30	0	100%

TABLE V

EFFECT OF MILK ON GASTRIC MOTILITY IN PRESENCE OF DUODENAL ULCER

Name	Gastric Acid Response	Time	Gastric Residue	
			Water	Milk
D. O.	Hyperacid	45 min.	0	85%
O. R.	Hyperacid	45 min.	0	70%
N. A.	Hyperacid	45 min.	5%	80%
D. I.	Hyperacid	30 min.	0	75%

TABLE VI

EFFECT OF CREAM ON GASTRIC MOTILITY IN PRESENCE OF DUODENAL ULCER

Name	Gastric Acid Response	Time	Gastric Residue	
			Water	Cream
D. O.	Hyperacid	45 min.	0	90%
O. R.	Hyperacid	45 min.	0	95%
N. A.	Hyperacid	45 min.	5	95%
D. I.	Hyperacid	30 min.	0	90%

TABLE VII

EFFECT OF DUODENAL INSTILLATION OF AA MILK ON GASTRIC MOTILITY IN PRESENCE OF DUODENAL ULCER

Name	Gastric Acid Response	Time	Drops per Minute	Gastric Residue	
				Control	Cream
S. K.	Hyperacid	60 min.	60	5%	80%
O. R.	Hyperacid	40 min.	60–80	0	70%
N. A.	Hyperacid	45 min.	70	5	75%
D. O.	Hyperacid	45 min.	100	0	85%

TABLE VIII

EFFECT OF DUODENAL INSTILLATION OF CREAM ON GASTRIC MOTILITY IN PRESENCE OF DUODENAL ULCER

Name	Gastric Acid Response	Time	Drops per Minute	Gastric Residue	
				Control	Cream
S. K.	Hyperacid	60 min.	25	5%	100%
O. R.	Hyperacid	45 min.	15	0	100%
N. A.	Hyperacid	45 min.	10–15	5%	100%
S. O.	Hyperacid	45 min.	30	0	100%

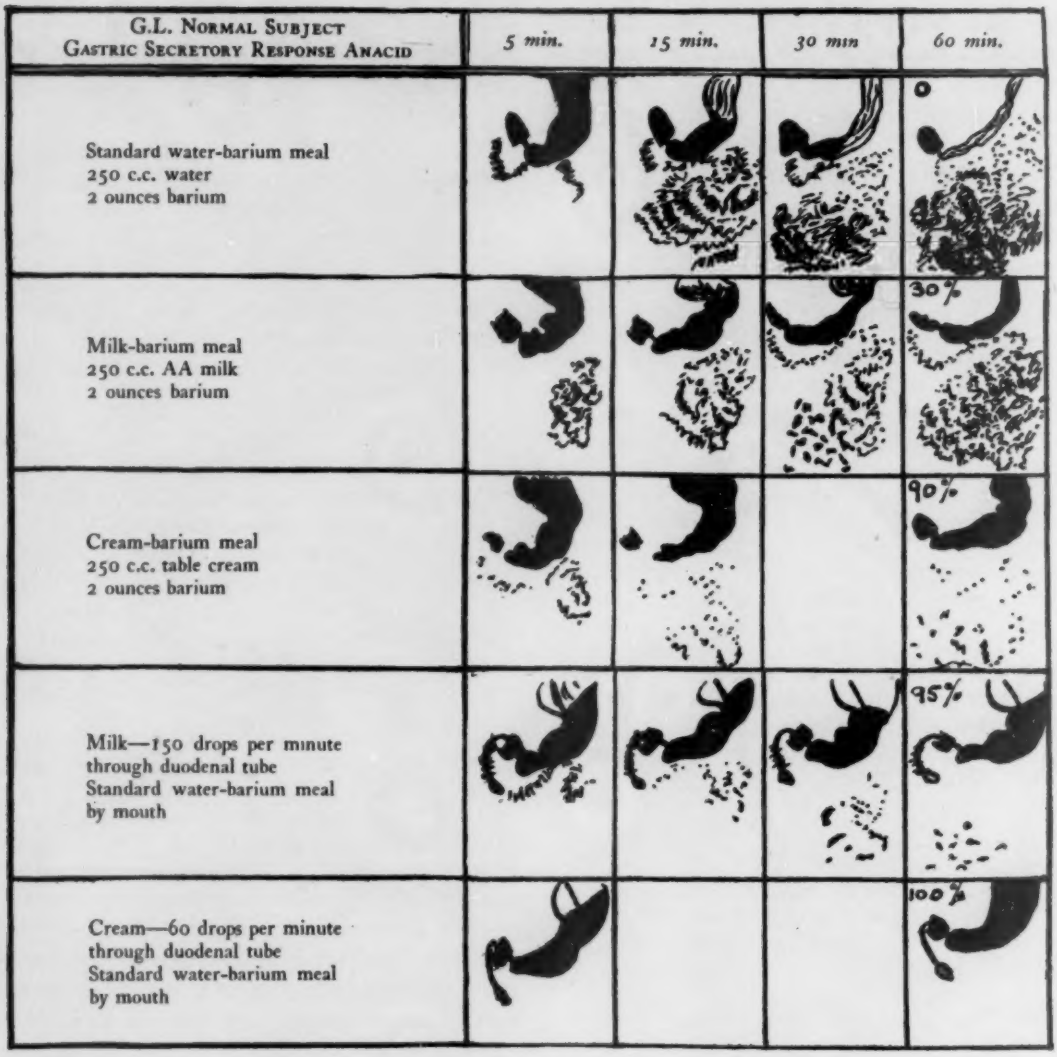


FIG 1.

loric action can be appreciated. For this reason, we will discuss fully two subjects: one with achlorhydria and one with hyperchlorhydria; also one with duodenal ulcer.

In Figure 1 are reproductions of roentgenograms made in the study of an anacid subject. *Water-barium meal*—roentgenoscopic notes—*Five minutes:* The head of the ingested column made steady progress through the stomach and pylorus into the duodenal cap without apparent interruption. The cap remained filled and the head of the column stopped at its apex. No gastric peristalsis was visible at the beginning; in about forty seconds one wave of subaverage intensity appeared and coursed symmetrically and without interference through the distal third of the stomach. Emptying was very slow at first and toward the end of the first five minutes was about commensurate with gastric peristalsis. *Fifteen minutes:* There was still one weak wave visible, coursing continuously through the distal third of the stomach. Evacuation rate seemed to be a little more than commensurate so that there was about a 60 per cent gastric residue at this time. *Thirty minutes:* Only about a 10 per cent gastric residue. No peristalsis visible in the stomach and the opaque contents seemed to be normally distributed in the jejunum and ileum.

Sixty minutes: Practically no residue in the stomach and an irregular distribution of the opaque contents in the jejunum and ileum.

It is worth noting that at each period of observation, the cap remained full. From the roentgenoscopic findings and from studying the intestinal patterns of the various roentgenograms, it appears that emptying of the stomach has taken place at irregular intervals. This subject was studied four times with a standard water-barium meal and each time gastric evacuation was practically complete at the end of sixty minutes. In this particular case, generally only one peristaltic wave was visible in the distal third of the stomach, but on one occasion, two waves were seen. No sufficiently characteristic changes in the contour of the stomach took place to permit us to differentiate between systole and diastole of the stomach or to correlate such changes with the time of gastric evacuation. The cap remaining full throughout the roentgenoscopic observations made it very difficult to know exactly when gastric evacuation was taking place through the pylorus.

In the same subject, with the *milk-barium meal*, the following roentgenoscopic observations were made. *Five minutes:* Evacuation continued until about 30 c.c. had entered the duodenum and upper jejunum. At first no gastric peristalsis was visible. In about two minutes, however, two asymmetrical waves coursed intermittently through the distal half of the stomach, but seldom as far as the pylorus. Gastric evacuation almost ceased and was, consequently, less than commensurate even with the weak peristaltic action of the stomach. The pylorus seemed closed. The cap remained full throughout this period with no visible contractions appearing even momentarily. *Fifteen minutes:* Two rather active peristaltic waves coursed through the distal two-thirds of the stomach symmetrically without interference and to the pylorus. The cap remained full but no evacuation seemed to be occurring, wave after wave reaching the pylorus. *Thirty minutes:* There was now about a 50 per cent gastric residue. The cap was full but not completely, and there seemed to be a light, even distribution of the opaque contents in the duodenal and upper jejunal segments. The valvulae conniventes were well outlined in the upper jejunal coils. One shallow peristaltic indenture was seen to course slowly along the greater curvature of the distal half of the stomach. *Sixty minutes:* No gastric peristalsis. The cap was still incompletely filled; there was about a 40 per cent residue.

With such observations, one cannot help but be impressed with the impotence of peristalsis as a force, per se, in gastric evacuation. Note, for example, the active peristalsis at the fifteen minute observation, with practically no emptying through the pylorus in contrast to the inactive peristalsis at the thirty minute observation with free evacuation.

The *cream-barium meal* examination revealed the following roentgen findings. *Five minutes:* Immediately after ingestion, a trial portion of about 30 c.c. rushed through the pylorus into the cap and onward into the duodenum and upper jejunal coils. Marked tonic pylorospasm, reflected backward into the antrum, followed immediately. The cap remained partially full. One or two waves appeared in the distal half of the stomach with indentures a little deeper on the lesser curvature than on the greater, and these progressed slowly toward the pylorus always disappearing in the midantrum without reaching the pylorus itself. Aside from the initial onrush of the trial portion, no motility was noted during this five minute period. *Fifteen minutes:* Pyloro- and antral spasms persisted and it seemed that the distal two-thirds of the stomach was in a moderate degree of contraction (see Fig. 2). One shallow peristaltic wave coursed through the middle third of the stomach and the cap remained partially filled. Apparently no evacuation had taken place since the last examination. The opaque contents comprising the trial portion were now faintly, but more or less uniformly distributed in the coils of small intestines in the left flank. *Thirty minutes:* No appreciable changes since the last examination. *Sixty minutes:* About a 90 per cent gastric residue was present at this time. The stomach seemed to be slightly contracted. The cap was almost full and a faint trace of opaque contents was visible at this time in the intestines.

FIG. 2. Spasm of the antrum including pylorus in an achlorhydric fifteen minutes after ingestion of a cream-barium meal which persisted for more than sixty minutes.

The pylorus was markedly affected during all these examinations. For the most part, it was either closed or in spasm and seemed to be the dominant factor in the regulation of gastric evacuation. The weak gastric peristalsis noted during the early observation did not affect evacuation, and the slightly increased tonic contraction of the entire stomach in the latter observations was equally ineffectual in emptying the stomach.

In the next experiment, the duodenal tube was passed through the pylorus and the bucket allowed to rest in the descending segment. *Milk* was allowed to drip through the bucket at the rate of *150 drops per minute.* After five minutes, the subject was allowed to drink the standard water-barium meal. *Five minutes:* About 25 c.c. of the opaque contents rushed through the pylorus into the duodenum comprising the so-called trial portion. The cap remained fairly well filled but there was no appreciable evacuation during the remainder of the five minute period. One shallow gastric peristaltic wave coursed along the lesser curvature, disappearing before reaching the pylorus; the pylorus, in turn, was open at first and then closed and remained tonically contracted. *Fifteen minutes:* There was no additional gastric motility. The pylorus was still contracted and there was a moderate antral spasm. The stomach, on the whole, seemed somewhat slightly contracted. The cap remained partially full and there was some slight residue of opaque contents visible in the descending duodenum. No gastric peristalsis was visible at this time. *Thirty minutes:* Pylorospasm persisted and the cap remained partially full. No gastric peristalsis was visible. No gastric evacuation had occurred since the last examination and there was about a 90 per cent residue visible at this time. *Sixty minutes:* Practically no changes in the roentgenoscopic or roentgenographic findings were noted.

The roentgenograms show the pylorus spastically contracted and associated with some antral spasm. From these observations, it is impossible to determine the degree of pylorospasm, yet the closure of the pylorus in the intact stomach appears to be the major factor in gastric retention. We might again recall that throughout all these observations, the duodenal cap remained fairly well filled and at no time showed irritability or contraction that resulted in expulsion of its contents. Also worth emphasizing is the absence of spasm of the duodenum around the tube in the descending segment or around the bucket in the same segment. In point of fact, from the width of the valvulae conniventes in the descending duodenal segment, there is apparently a slight dilatation of the lumen (see Fig. 3).

Of greater interest than the findings of the above experiment are those recorded with *cream dripped into the duodenum at the rate of 60 drops per minute. Five minutes:* The duodenal cap filled immediately and remained full during this period. The stomach seemed moderately contracted as if in systole. No gastric peristaltic activity was noted. The head of the barium column did not progress beyond the

tip of the duodenal cap. The pylorus seemed closed around the tube which passed through it, but there was apparently no real spasm and certainly no associated antral spasm.

Very few alterations occurred in the gastroduodenal activity during the succeeding observations. At the end of an hour the residue in the stomach was the same as at five minutes. No gastric peristalsis was visible, the pylorus was still closed and the cap was full. Some shallow undulations in the margins of the cap were noted but never real contraction with emptying. The head of the column had not progressed beyond the tip of the duodenal cap and so long as cream, at a rate as low as 60 drops per minute, was allowed to drip into the duodenum, these conditions remained unchanged. From several other experiments, it was found that it usually takes from forty-five to sixty minutes after the duodenal drip is stopped for the effects produced above to wear off. The peristalsis and motility follow as with the standard water-barium meal. The above observations were made in a normal subject with gastric anacidity. For comparison, the roentgen studies in a subject with a slight gastric hyperacidity are detailed (Fig. 4).

The standard water-barium meal—Five minutes: Three peristaltic waves appeared in the stomach immediately, the cap filled instantly, and there was progressive filling of the distal duodenal segments. Rate of evacuation seemed commensurate with gastric peristalsis and the pylorus apparently opened and closed intermittently. *Fifteen minutes:* Gastroduodenal activity continued practically unchanged and at this time there was about a 70 per cent residue in the stomach. *Thirty minutes:* No appreciable changes were noted in the motor activity of the stomach or duodenum except that the cap contracted intermittently and emptied completely. About 40 per cent residue was visible in the stomach. *Sixty minutes:* The stomach and duodenum were practically empty, only enough barium residue remaining to coat the mucosa.

The milk meal—Five minutes: The cap filled immediately, followed by continuous closure of the pylorus. Two peristaltic waves of less than average intensity were noted. Evacuation was less than commensurate. The trial portion that passed through the pylorus filled the duodenal cap allowing a small amount to advance into the more distal duodenal segments. *Fifteen minutes:* Tonic pylorospasm was present at this time. The cap was full and no gastric peristalsis or evacuation was visible. Motor activity in the cap was not noted. *Thirty minutes:* Slight pylorospasm persisted. One wave of less than average intensity coursed through the distal third of the stomach, the cap remained full in spite of slight intermittent contraction. Some gastric evacuation had taken place so that there was about a 90 per cent residue. *Sixty minutes:* Approximately a 75 per cent retention was noted at this time with no appreciable changes in gastric or duodenal peristalsis or in pyloric patency. At this time, the standard water-barium meal had been previously completed emptied.

The cream meal—Five minutes: A slight rush of contents into the cap occurred, followed by

Fig. 3. Pylorospasm—duodenum not contracted as indicated by width of valvulae conniventes, milk dripped into duodenum 150 drops per minute.

tonic antral spasm. Two waves coursed with progressively increasing intensity through the distal half of the stomach but only after the sixth wave had reached the pylorus did the cap fill fully and then there was a further on-

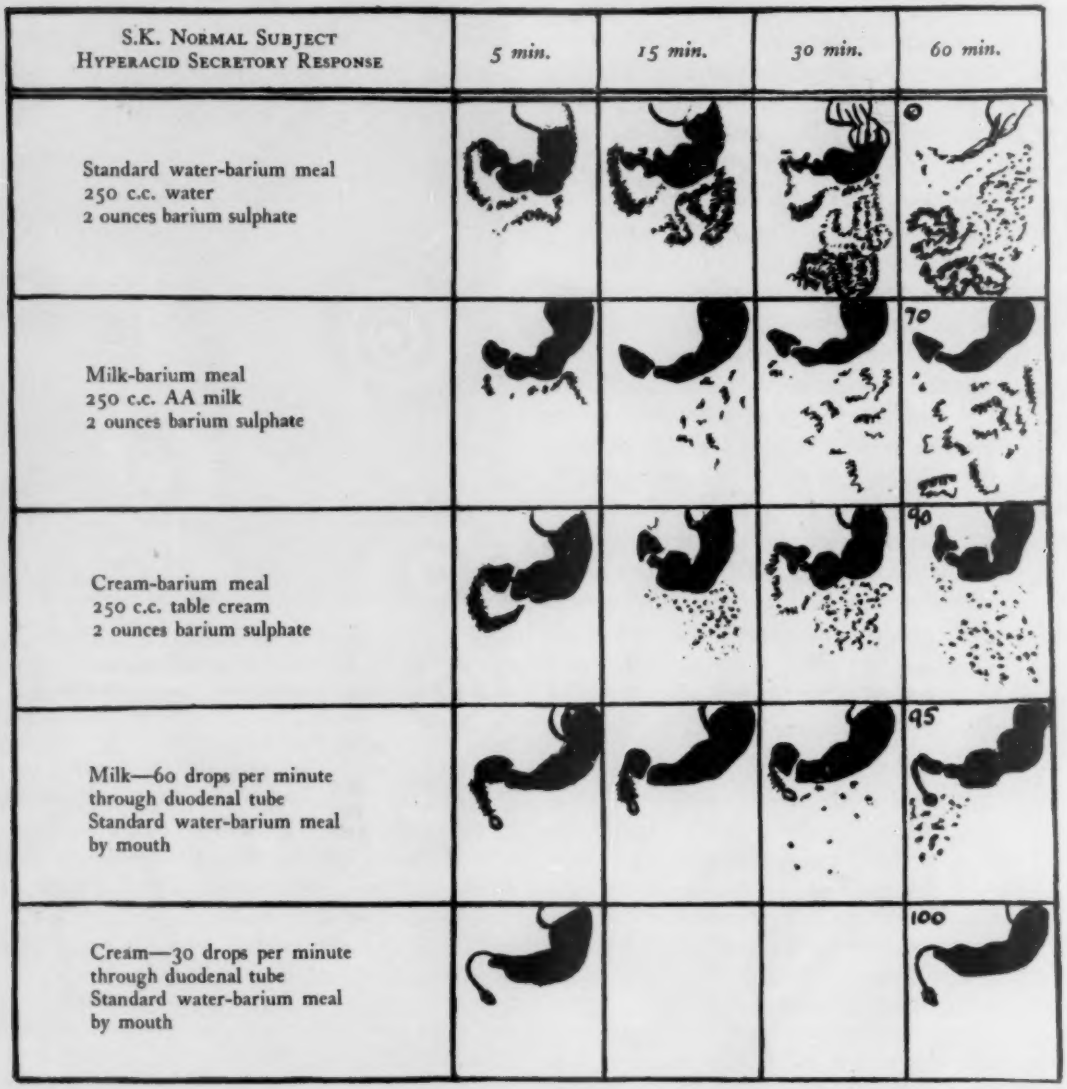


FIG. 4

rush of approximately 40 c.c. of cream, the head of the column reaching as far as the duodenojejunal junction. Stasis followed in the duodenum and continued for five or six minutes. Slight intermittent hyperperistalsis and antiperistalsis were noted in these segments before the head of the column made further progress into the jejunum. In the meantime, the stomach became passive, slightly dilated and peristalsis disappeared. *Fifteen minutes:* Tonic pylorospasm was present at this time with a slight spasm of the distal antrum with intermittent antiperistalsis distinctly noted in the distal third of the stomach. The cap remained full and exhibited no peristalsis. *Thirty minutes:* Two peristaltic waves of average intensity coursed continuously, symmetrically and without interference, through the distal half of the stomach to the pylorus. The cap remained partially full and occasionally contracted. There was some evacuation

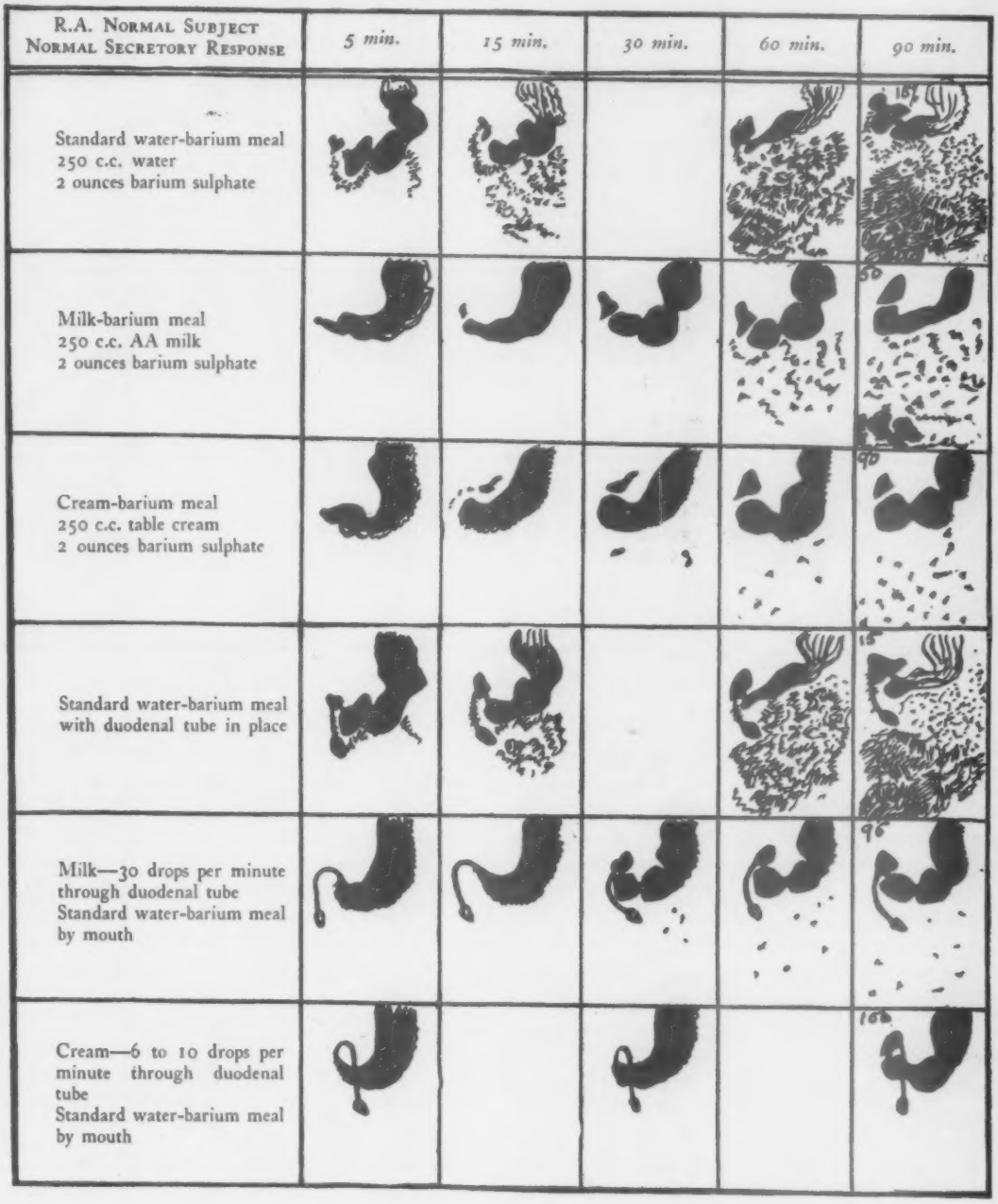


Fig. 5

present at this time but less than commensurate with peristalsis. The pylorus seemed to open and close intermittently, but for the most part was tonically contracted. *Sixty minutes:* The cap was still full and inactive. Two waves still coursed through the distal half of the stomach which seemed to be in a moderate degree of continuous relaxation and practically none of the opaque contents had left the stomach. There was approximately an 85 per cent residue.

Milk dripping into the duodenum through a tube at the rate of 60 drops per minute resulted in the following changes in the evacuation of the standard water-barium meal taken five minutes after the dripping of the milk was

O.R.—DUODENAL ULCER—STANDARD WATER-BARIUM MEAL BY MOUTH

5 min.		A large trial portion rushed through the pylorus at the beginning of the examination after which the cap filled and remained practically completely and constantly filled throughout the remainder of the period, contracting only once. Two waves of average intensity coursed continuously through the distal half of the stomach. The pylorus seemed more or less constantly closed throughout the study.
15 min.		No gastric peristalsis visible. Motility has been good. The cap remained more or less constantly filled and contracted very rarely. Some slight prolapsus seems to be tonically present at the pylorus; 40 per cent gastric residue.
45 min.		Stomach practically empty. Cap still filled.

FIG. 6

begun. *Five minutes:* The duodenal cap filled immediately and the head of the column proceeded as far as the tip of the tube. No peristalsis was noted in the stomach or cap but in the descending duodenal segment, intermittent antiperistalsis was observed. The distal half of the stomach seemed slightly contracted as if the stomach were in a state of slight tonic systole. No progress of the head of the column took place beyond the tip of the duodenal tube. *Fifteen minutes:* No appreciable changes had occurred. *Thirty minutes:* No appreciable changes except that about 5 c.c. of the opaque contents had progressed beyond the tip of the duodenal tube and was distributed in flaky fashion in the upper jejunum. *Sixty minutes:* Practically no changes discerned except that one weak peristaltic wave seemed to course continuously through the distal third of the stomach. The pylorus was still closed. The cap was full and inactive. No opaque contents were visible in the duodenum distal to the cap.

Cream—30 drops per minute into the duodenum. Five minutes: The stomach contracted as it filled, especially the antral portion. The pylorus was tightly closed and there was on filling of the cap whatsoever. No peristalsis was visible in the stomach. This contracted state of the stomach persisted throughout the succeeding observations, so that at the end of one hour there were practically no changes. We were able to produce similar effects in other subjects with as little as 6 to 9 drops of cream per minute dripping through the duodenal tube. It is worth recording that as previously reported for acids and alkalis, the intensity of gastric and pyloric response is in proportion to the intensity of the stimulus; milk and cream differing essentially only in fat content, it is seen that the degree of pyloric contraction, antral spasm and delay in gastric evacuation are greatest when the strongest stimulant, the cream in this series, is applied to the duodenal mucosa.

Figure 5 pictures the response to the test substances in a subject with normal acidity. Details of the roentgenoscopic and roentgenographic examinations are omitted because they parallel those studies already described. Similar observations were made, too, in the subjects with quiescent duodenal ulcer, and a review of the roentgenoscopic findings are included with pen and ink drawings of the roentgenograms (Figs. 6–10).

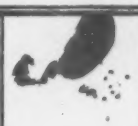
O.R.—Duodenal Ulcer—Milk 250 c.c., Grade AA, by Mouth		
5 min.		Cap still remained partially filled. Intermittent antral spasm noted but otherwise no peristalsis and no motility.
15 min.		The cap is full. One wave traveled through antrum three times with decreased intensity followed by tonic pyloro and antral spasm. Peristalsis ceased and motility stopped.
30 min.		Roentgenoscopic observations at this time were essentially the same as recorded at the fifteen minute period. No films made.
45 min.		Antral spasm still present but of varying intensity. No peristalsis. The cap faintly filled. No motility.
60 min.		Roentgenoscopic observations at this time essentially as above reported. No record made.
90 min.		Intermittent peristalsis noted at this time. Sometimes one, at other times two waves of average intensity coursing through the distal half of the stomach. The cap was completely filled. Motility very intermittent, the cap contracting and emptying only at long intervals. About 90 per cent gastric residue at this time.

Fig. 7

Factors in the Mechanism Controlling Gastric Evacuation as Revealed by Studies with Water, Milk and Cream

In order to evaluate the elements comprising the delicately regulated mechanism of gastric evacuation, it might be well to consider these separately.

Peristalsis. It is easy to understand how a ring of contraction moving forward in the stomach could evolve the picture of peristalsis as the evacuating force of the

O.R.—DUODENAL ULCER—CREAM 250 C.C. BY MOUTH

5 min.		A trial portion of about 15 c.c. rushed through the pylorus followed almost immediately by continuous tonic pylorospasm. The cap remained filled. No peristaltic waves were visible and no motility took place in this interval.
15 min.		The cap remained filled. Two peristaltic waves of decreased intensity coursed continuously through the distal half of the stomach. Slight continuous tonic pylorospasm noted and no motility.
30 min.		Roentgenoscopic findings essentially as above.
60 min.		Pylorospasm now somewhat decreased in intensity. Two peristaltic waves, more intense than at previous observation, coursing through the distal two-thirds of the stomach, intermittent evacuation taking place from the stomach. About 90 per cent gastric residue.
90 min.		Two peristaltic waves still visible in the stomach but distinctly less intense than at the sixty minute observation. Cap still filled. Motility a little more rapid than above. Residue about 85 per cent (evacuation time in this patient with standard water barium meal is 45 minutes).

FIG. 8

stomach. If the peristaltic contraction ring were so complete as to progressively obliterate the stomach lumen in this onward motion, permitting no reflux; if the pyloric sphincter were not present, and if the opening and closing of the pylorus were synchronous at all times with gastric peristaltalsis, then one could concede peristalsis determining gastric evacuation.* Today we can actually see peristalsis in vivo under practically normal conditions with the aid of roentgen rays, but this has its limitations. The study of peristalsis with inflated balloons in the stomach is limited because these methods cannot measure actual gastric evacuation. Many questions with which the clinical gastroenterologist and roentgenologist are frequently confronted are still unanswered by pure physiological research. For instance, if peristaltic activity determines gastric motility, then why does the roentgenologist at times see no motility from the stomach when he ob-

* It may be interesting to review here briefly the development of experimental investigations on this phase of gastric activity before proceeding with our own comments. As late as 1894, some investigators, like Mueller,[17] were theorizing about peristalsis from their findings in the cadaver. Shortly afterward, other writers proved that it was the asphyxia, chilling, and contact with air which caused violent contractions seen in the segments of the gastrointestinal tract at death. Yet Rossbach,[23] studying the viscera in living animals through glass windows in the abdominal wall, noticed movement in the stomach. Even Marbaix,[12] in 1898, felt that Kussmaul's observations of visible peristalsis through the attenuated walls of the abdomen were isolated cases of mechanical stenosis of the pylorus.

O.R.—Duodenal Ulcer—Cream—15 Drops per Minute through Duodenal Tube—Standard Water Barium Meal by Mouth

5 min.		About 1 c.c. of water barium meal has entered the cap. Stomach was in a passive state. No visible peristalsis. Continued tonic pylorospasm noted with no motility.
45 min.		Practically no changes since the last examination (30 c.c. of cream has passed through the duodenal tube). *Instillation of cream stopped after this observation.*
Five minutes after stopping cream		Five minutes after instillation of cream through tube was stopped. No appreciable changes noted roentgenoscopically since the last examination.
Thirty minutes after stopping cream		No peristalsis visible. Duodenum filled. Pylorus tonically contracted with momentary relaxation allowing the cap to fill moderately, motility taking place intermittently for the first time.
Forty-five minutes after stopping cream		Intermittent paroxysmal hyperperistalsis now noted. Cap remains filled most of the time. Motility quite rapid but intermittent. About a 50 per cent gastric residue. Upper jejunal coils emptied quickly due to rapid motility of the opaque contents in this section of the small intestines.

Fig. 9

serves deep, quickly moving waves coursing through it to the pylorus? Or, why does he, at other times, observe, without any visible peristalsis in the stomach, a rapid continuous outpouring of the contents through the pylorus, particularly in patients with low gastric acid secretions or in achlorhydrics? Or, why is it that in normal individuals, the roentgenologist frequently finds at one period of the examination an evacuation less than commensurate with peristalsis and at another time, more than commensurate—even in the presence of normal peristalsis of average intensity, three to four waves coursing continuously, symmetrically and without interference the entire length of the stomach.

From our observations, peristalsis generally appears in the stomach as soon as the head of the ingested column has entered the cardiac end of the stomach. This was observed with greater regularity in normal subjects than in those with quiescent duodenal ulcer. Sometimes the waves are so shallow as to be observed with great difficulty; at other times they are deep, appear with a rapidity and intensity of action that are striking. Ordinarily, evacuation takes place while gastric peristaltic activity is discernible, but adequate gastric evacuation may occur without peristalsis, especially in cases with anacidity. Nor do we believe that each peristaltic wave results in some degree of evacuation. We agree with Oppenheimer,[18] Hirsch,[8] Pavloff,[19] Cannon,[4] and others, that evacuation through the pylorus takes place at irregular intervals which are not definitely related to gastric peristalsis. Our data do not

N.A.—Duodenal Ulcer—Standard Water Barium Meal by Mouth		
5 min.		Cap filled immediately; intense continuous peristalsis, two to four waves; cap active; contracted frequently. Motility commensurate with peristalsis.
15 min.		Intermittent paroxysmal hyperperistalsis; cap contracted and emptied at short intervals. Gastric residue 50 per cent.
45 min.		Stomach empty.
N.A.—Duodenal Ulcer—Milk—70 Drops per Minute through Duodenal Tube—Standard Water Barium Meal by Mouth		
5 min.		Cap filled immediately. Mild antral spasm ensued and continued. No peristalsis and no motility noted.
15 min.		Practically no changes except some slight increase in the intensity of antral spasm.
45 min.		Tip of duodenal tube has slipped back into duodenal cap. Otherwise no appreciable roentgenoscopic changes since the last examination.

FIG. 10

agree with those of Roux and Balthazard,[24] who concluded from their observations on dogs that food entered the duodenum at the completion of each peristaltic wave. Luckhardt, Phillips and Carlson,[12] and Wheelon and Thomas,[26] likewise concluded that peristalsis and motility were directly related. But on closer analysis of their work, one finds that these investigators at times found no relationship between peristalsis and evacuation. When Luckhardt, Phillips and Carlson induced pylorospasm mechanically by irritation of the duodenal mucous membrane, they noted wave after wave of gastric peristalsis coursing through the stomach without ejection of chyme.

Brunemeier and Carlson[3] concluded from studies on dogs that mechanical and chemical stimulation of the intestinal mucous membrane caused inhibition of hunger contractions and that chemical stimulation produced the greater effect. In our own

studies in human subjects with acids and alkalis we have observed a similar inhibiting influence. Like the effect of such stimulation upon pyloric function, the degree of peristaltic inhibition appears to be related to the intensity of the intestinal stimulus. In the case of milk and cream, this stimulus is provided by the fat content. These observations, too, permit an explanation of the intermittent paroxysmal hyperperistalsis common with duodenal ulcer. We previously postulated, on cited evidence, that the duodenal neutralizing mechanism in hyperchlorhydrics may be highly developed.

In the case of duodenal ulcer, the entrance into the duodenum of the highly acid gastric chyme results in active stimulation of intestinal mucosa with rapid closure of the pylorus and a rapid cessation of gastric peristalsis. The duodenal neutralizing mechanism diminishes this stimulus so that pyloric relaxation starts and gastric peristalsis is again inaugurated. If this neutralizing mechanism is highly developed, duodenal neutralization will take place rapidly, peristalsis will develop quickly and intensely and with the pylorus open, further evacuation ensues. As a result of the more rapid intermittent neutralization in the duodenum, a more rapid emptying of the barium meal, so frequently seen by the roentgenologist in uncomplicated duodenal ulcer, will result. Such phenomena were not observed with the milk and cream meals. This illustrates again, as we shall have occasion to reiterate in our report on the behavior of the operated stomach, *that the roentgenologist in recording motor phenomena observed in the stomach must limit his conclusions to the particular meal used.*

Gastric Tone. The evaluation of tone as a factor in gastric motility is possible only inferentially from our experiments. During the course of gastric evacuation, the progressive diminution in the size of the gastric silhouette is difficult to differentiate from a contraction in the size of the stomach due to increased tone. Moreover, when it was found that evacuation from the passively relaxed stomach (e.g. in achlorhydria) could occur just as rapidly as from one contracted, tone as an essential factor in gastric evacuation became questionable.

Quincke,[21] in 1889, noted with astonishment in an infant with a gastric fistula that a slight intragastric tension of 15 to 20 mm. of water could not be tolerated. Mueller,[17] five years earlier, had maintained that the intragastric tension of rabbits' stomachs remained absolutely fixed during all his experiments. In 1896, Kelling[10] observed that within certain limits, gastric tension remained the same despite different volumes of contents. Moritz[16] showed that an elastic bulb introduced into the pyloric portion was subjected to special variations of pressure much more marked than those exerted on a larger bulb in the fundus. When, in 1895, he reviewed the problem of gastric evacuation, in its relationship to intragastric tension, he concluded that the variable tensions in the interior of the stomach were due entirely to the adjoining organs, such as the heart, lungs, liver and other abdominal viscera. Gianturco,[7] much impressed with the work of Kelling and Moritz, was able to make confirmatory studies in dogs and humans. He found that with the gastric contents increased from 5 to 100 c.c. there occurred no increase in gastric pressure, but from 100 c.c. onward, this relaxation did not keep pace with the increased volume of gastric contents, and intragastric pressure rose rapidly; furthermore, by repeating his experiments after excising the fundus of the stomach, he found that this ability of adaptation was confined mostly to the fundic portion of the stomach. He concluded that the increased gastric pressure which comes after the stomach has been distended to a certain point is largely due to the force required to stretch the abdominal wall and not the stomach wall. We found in some other studies with the human that the rate of emptying and quantity of a meal tended to be directly related. If a subject emptied a 250 c.c. standard water-barium meal in thirty minutes, it took from ninety to 120 minutes to empty a 1,000 c.c. water-

barium meal. According to Gianturco's findings, we certainly raised the tension of the stomach considerably, yet we did not obtain a proportionate increased speed of gastric evacuation. Gianturco further found from studies on the cat that emptying was more rapid in the fundusectomized stomach following increased intragastric pressure produced by increasing gastric volume than in the normal stomach.

Pyloric Mechanism. There is probably no structure in the body studied so extensively, whose action has proved so interesting, and which continues so attractive a source of speculation, as the pyloric sphincter. It engaged the attention of the earliest anatomists and its function was placed in a spiritual realm by medieval physiologists. It is remarkable that even today there is such a divergence of opinion as to its rôle in gastric evacuation. There are those like Cannon who insist that it functions as a true valve and that nature would not allow such a fine anatomical arrangement to be functionless. Others, like Cole,[5] are quite doubtful of its perfection as an anatomical valve and its action as a true sphincter.

From the roentgen studies, during the early stages of *milk* digestion, the pylorus appears to be closed and even spastically contracted—with the cream meal, this closure is positively discernible in the roentgenograms. In fact, the spasm of the pylorus, with the cream meal, is so marked that it is reflected backward into the antrum and forward into the cap *so that the duodenal cap, the pylorus and the antrum of the stomach are all three contracted simultaneously.* During this phase of contraction of the pylorus, complete cessation of gastric peristalsis is also present. As digestion proceeds, the duodenal cap fills and remains more or less full, contracting quickly at intervals. These intervals are long at first and grow progressively shorter as digestion proceeds. The pylorus, likewise, probably opens and closes at progressively shorter intervals, the rhythm not synchronous with the contractions of the duodenal cap. Gastric peristalsis, too, develops with increased intensity and though inaugurated simultaneously with pyloric and duodenal cap activity, its rhythm is not necessarily synchronous with the opening and closing of the pylorus or with the peristaltic contractions in the duodenal cap. Motility becomes rapid and, likely as not, more than commensurate with gastric peristalsis. If we can infer from Lintvareff's[11] observations that the achlorhydric is apparently deficient in intestinal juices, it would follow then, that a substance found irritating to the intestinal mucosa of a normal subject would be irritating for a longer period in an achlorhydric. And such seems to be the case. It has been found that milk and cream are more slowly evacuated from the achlorhydric stomach than from one with a normal acid secretory response. The hyperchlorhydric stomach, on the other hand, evacuated the same test substances more rapidly. These changes were more pronounced with our acid-alkali experiments.

It was also Lintvareff who noted that the introduction of 100 c.c. of olive oil into the duodenum prolonged evacuation and he concluded definitely that the introduction of substances such as olive oil, butter, and cream into the duodenum reflexly closes the pylorus and permits no liquids to pass from the stomach for a considerable period of time. Not only may the pylorus contract, but also with it, the stomach and the duodenal cap. Lintvareff noted that this reflex develops very quickly, rapidly increases and then slowly subsides. Our work is entirely in agreement with these findings.

The phrase "trial portion" was first used by Lintvareff and this neatly labeled the initial outrush of the ingested meal through the pylorus into the duodenum. He noted in all his experiments that the first portion of liquids, regardless of the reaction, easily and rapidly left the stomach. This has generally been our experience in the thousands of observations we have made in humans, but it is not a constant finding. Occasionally, egress of the meal through the pylorus is not seen for the

first few seconds or even minutes, in spite of the fact that several peristaltic waves may course through the stomach ending sharply at the pylorus. What, other than a closed pylorus, could effect this block of the head of the gastric column? Pendergrass, Ravdin, Miller and Abbott have done careful well-planned experiments, shown in the Scientific Exhibit of the American Medical Association and later at the meeting of the American Roentgen Ray Society at Atlantic City in 1935, on gastric motor phenomena and intestinal patterns, beautifully demonstrating the effects on gastric motility with various substances such as glucose and fats in various concentrations. While our findings substantially agree, there is a tendency to a different interpretation as to the effectiveness of pyloric control in gastric evacuation. They are inclined to assign to spasm and contraction of the duodenum, a more determinant factor in preventing gastric evacuation with hypertonic sugar or fat solutions than to the function of the pylorus; we have repeatedly shown, however, that the duodenum is dilated and not contracted when fats or hypertonic solutions come in contact with its mucosa (see Figs. 11 and 12).

Fig. 11. Gastric retention after 50 c.c. olive oil had been slowly dripped into jejunum. A Miller* double barrel tube has been passed through the pylorus into duodenum and jejunum where the distal tip lies, 40 cm. distal to opening in other barrel, whose position is marked by presence of steel plug just beyond the opening. This film was made fifteen minutes after ingestion of a 250 c.c. water-barium meal. The cap is slightly filled and there is a faint trace of opaque contents in the descending duodenal segment.

* The Miller double aud triple barrel tubes have been of inestimable aid to us in our recent experiments and we regard them as much more useful than the older duodenal tubes.[13]

Fig. 12. Dilatation of duodenum with gastric retention after 50 c.c. olive oil had been slowly dripped into the jejunum. Same case as in Figure 11, 100 c.c. of water containing only barium instilled into duodenum through other barrel of Miller tube. The duodenum is dilated, no indentations of the margins by the valvulae conniventes and no motor activity were seen in *the segment for forty-five minutes*. The head of the duodenal column made no advance beyond the duodenojejunal junction; no evacuation from the stomach was apparent and no gastric peristalsis or other motor activity was seen, the antrum remaining motionless, narrow and tubular.

Pavloff[19] (1910) agreed with Lintvareff that the effect of milk in the duodenum on

the function of the pylorus was due principally to the fat contained in the milk; that fat and fatty foods, as well as soap, produced a reflex closure of the pylorus after coming in contact with the duodenal mucous membrane. Roberts,[22] in studying the effects of various oils on gastric motility, found that the higher the iodine number, or the less saturated the oil, the more marked the gastric motor delay. He found that viscosity had no relationship to gastric motility. He at first thought oil formed a layer over the gastric mucous membrane, thus shielding it from stimulation by food and aqueous solutions within. Yet he found that liquid paraffin, whether emulsified with agar or plain, was entirely without action on gastric secretion and motility. *We likewise noted the same phenomenon many times.* In testing evacuation with meals of liquid petrolatum in concentration as high as 25 per cent, we noted no difference from the standard water-barium meal. Liquid petrolatum is a pure hydrocarbon, differing materially from the chemical compositions of the oils. Roberts, in all his experiments, gained the impression that the main action of the oil took place after it left the stomach. He obtained the most marked inhibitory effect on gastric motility when he introduced oil directly into the intestines, thus strongly suggesting that oil exerted its effect only after it had left the stomach and entered the duodenum. He found, as we did, that the inhibitory effect was most marked in achlorhydrics. He thought this effect was due to the filling or distention of the small intestines reflexly slowing gastric evacuation. This suggested that it might be used to great advantage in preceding hydrochloric acid administration in the treatment of achlorhydrics.

Oppenheimer (1889) and Hirsch (1893) concluded also that gastric evacuation was reflexly controlled, to some extent, by stimuli in the intestines. Quigley, Zettelman and Ivy[20] and Farrell and Ivy[6] demonstrated beautifully in their experiments that the initiation of gastric inhibition is dependent upon contact of fat with the mucosa of the small intestines, for the phenomenon is initiated by fat restricted to the duodenum and jejunum, but not by fat limited to contact with the gastric mucosa. They believed that a humoral agent was involved and that the agent was probably a chalone. They probably rightly concede that, under normal circumstances, an inhibitory process may involve both a nervous and a humoral mechanism, but that it is possible for the latter to act readily and completely in the absence of the former. Although these workers do not claim that this humoral agent affects gastric inhibition by closure of the pylorus, our experiments strongly suggest that such is the most important factor in the mechanism. Our own findings even indicate that the effect varies quantitatively, for when the stimulus to the intestinal mucosa is very marked, not only is there a contraction of the pylorus, but *also of the antrum.* In subjects with partial gastrectomy, inhibition of gastric evacuation resulted from the same experimental procedures as occurred in the intact gastrointestinal tract. While we believe with McCann[14] that, in the intact gastrointestinal system, the pylorus is the segment most involved in determining gastric evacuation, we nevertheless realize that in the absence of the pylorus evacuation may be controlled by the remaining segments. Further, provided no gastric secretory changes have occurred as the result of the operation, the character of the evacuation may remain essentially unchanged.

Apperly[1] has ascribed to altered osmotic tensions of substances coming in contact with the intestinal mucosa a reflex effect on the action of the pylorus. A similar view was expressed by Johnston and Ravdin[9] who have demonstrated this action for hypertonic glucose solution in dogs. Our own experiments, to be detailed elsewhere, with hypertonic salt, sugar and bicarbonate solutions clearly confirm such an opinion. Gastric motor delay is almost directly related to concentrations of any of these substances as they reach the intestinal mucosa.

The Duodenal Cap as a Factor in the Control of Gastric Evacuation. While the independent action of the pylorus as a part of the mechanism involved in gastric evacuation has been open to question, little doubt has been raised regarding the independence of the rhythmic contractions of the duodenal cap compared with those of gastric peristalsis. In examining our serial films, in the experiments after the duodenal instillation of milk and of cream, one notices not only pylorospasm and antral spasm, but complete spastic contraction of the duodenal cap. These findings support the view of Wheelon and Thomas that the antrum, pylorus and duodenum can react as a single unit. In other words, it seems that when the stimulus to inhibit gastric evacuation is intense enough, not only is pyloric contraction induced, but also antral spasm and tonic contraction of the duodenal cap itself. When the stimulus to the duodenal mucosa is not quite so intense as in the later stages of digestion of a milk or cream meal by mouth, only pylorospasm and antral spasm result, the cap remaining quite well filled and relaxed. Finally, when the stimulus to the intestinal mucosa is minimal, as in all our experiments with the water meal in patients with normal gastric acidity, intermittent contraction of the duodenal cap takes place, but usually with a rhythm of its own and different from that of gastric peristalsis. Since the duodenal cap is usually found full and relaxed, more or less constantly, when the substances entering the more distal segments are not too irritating, or are quickly rendered so, and since any number of gastric peristaltic waves may reach the pylorus before evacuation takes place, what can it be other than the pylorus which prevents the cap from overfilling and the contents from overflowing into the intestines? When the intestinal pyloric reflex seems completely abolished and chyme becomes acceptable to the small intestines, then the rhythm of contraction of the duodenal cap is frequently faster than gastric peristalsis or the opening and closing of the pylorus.

SUMMARY

Roentgenologic studies were made in a group of 7 normal subjects and in another group of 4 with quiescent duodenal ulcer. The effects on gastric evacuation with meals of water, milk and cream were studied in both groups and attempts were made to analyze and compare our results with the findings of others using different materials and methods. The effects of these substances on the various intrinsic factors in the mechanism controlling gastric evacuation were studied and compared with the effects of acids and alkalis on the control of the pylorus previously reported. Our findings reaffirm the known marked delay of gastric evacuation caused by the ingestion of milk and cream. The direct application of milk and cream to the duodenal mucosa through a duodenal tube produced a more pronounced delay in gastric evacuation than when taken by mouth. The most marked effects of these ingested materials were noted at the beginning of digestion and were characterized chiefly by spastic contraction of the pylorus with cessation of gastric peristalsis. When this effect was intensified by direct application of milk and cream beyond the pylorus, spasm of the duodenal cap and antrum occurred simultaneously, all three anatomical units acting as one. As digestion proceeded, spasm of the pylorus changed from a tonic to a clonic type, opening and closing of the pylorus becom ing intermittent. Gastric peristalsis gradu ally returned to normal and intermittent filling and contraction of the duodenal cap followed. Gastric evacuation ensued when the duodenal cap and pylorus were opened simultaneously. The subjects with quiescent duodenal ulcer differ from the normal only in that after disappearance of the initial pyloro- and antral spasm, gastric peristalsis was intermittently markedly intensified rather than evenly vigorous. Emptying of water was quickest in the achlorhydric and in the quiescent duodenal ulcer group with hyperchlorhydria, but emptying of milk and cream was slightly slower in the achlorhydrics than in the hyperchlorhydrics.

An analysis of the elements of gastric evacuation would lead us to believe that the pylorus can and does function as a true sphincter; that an intestinal mechanism probably both nervous and through the action of a humoral agent or chalone controls this action of the pylorus during digestion; that the intensity of this control of pyloric action is proportionate to the fat content of milk and cream and that, finally, the sphincteric action of the pylorus is the principal element governing gastric evacuation in the intact gastrointestinal tract.

It appears that the tested substances act in controlling gastric evacuation very much like strong acids and alkalis, the action being more intense and longer sustained. Gastric peristalsis and tonus have a definite bearing on gastric evacuation when the pylorus is open.

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RATE OF DEPOSITION OF THOROTRAST IN THE HUMAN LIVER AND SPLEEN*

By WALLACE M. YATER, M.D.
WASHINGTON, D.C.

HEPATOSPLENOGRAPHY with stabilized thorium dioxide sol (thorotrast, Heyden) has not become as popular as its diagnostic value warrants. This is due largely to reticence because of the possibility of harm resulting years after the intravenous injection of this radiopaque material. Elimination from the body is very slow, requiring an unknown number of years, and the result of myriads of foreign bodies of even a small degree of radioactivity remaining so long in the tissues is largely unknown. However, Yater, Otell and Hussey[2] have used thorotrast in several hundred patients during the past five years and for hepatosplenography in considerably more than two hundred of these. A recent follow-up study of the first 200 patients failed to reveal evidence of any harmful effects due to thorotrast.

The doses used have ranged from 15 c.c. in young children to 100 c.c. in adults, the average dosage for adults having been 75 c.c. By the technique originally described by Yater and Otell,[1] 25 c.c. was given on each of three successive days and the diagnostic films made on the fourth day. For the purpose of determining whether there might be rupture of the liver or spleen in accident cases, 25 c.c. was recommended for injection followed in four hours by the making of the exposures. Such films are only fairly satisfactory.

FIG. 1. Routine flat film of abdomen before injection of thorotrast.

FIG. 2. Hepatosplenogram made fifteen minutes after intravenous injection of 65 c.c. of thorotrast. Liver and spleen already visible.

Dividing the total amount of thorotrast to be used is not necessary when haste is important. The amount employed in the Georgetown University and Gallinger Municipal Hospitals is 0.5 c.c. for each pound of body weight up to 75 c.c. Repeated experience has shown that the total dosage may be given in one injection with negligible immediate reactions if the patient is not seriously ill.

In order to ascertain the rate of deposition of the medium in the liver and spleen when the entire amount is injected at one dose, films were made of a patient before the injection, fifteen minutes afterward, every half hour for four hours, every hour

*From the Georgetown University School of Medicine and the Gallinger Municipal Hospital, Washington, D. C.

Fig. 3. Hepatosplenogram made forty-five minutes after the injection. Liver and spleen more definite; metastases suggested.

Fig. 4. Hepatosplenogram made one hour and fifteen minutes after the injection. Metastases in liver definitely shown.

for four more hours and then again the following day. The patient selected was a negro, aged sixty, who gave a history suggestive of gastric disease and whose gastrointestinal roentgen study revealed the presence of a large filling defect along the greater curvature with shortening of the lesser curvature. The diagnosis made was extensive scirrhous carcinoma of the stomach although the gastric analysis showed hyperacidity. Figure 1 is a reproduction of the roentgenogram made before the single injection of 65 c.c. of thorotrast. Figure 2 shows the appearance fifteen minutes after the injection; even at this time there has been sufficient medium deposited in the liver and spleen to make these organs vaguely demonstrable. Figure 3 demonstrates a fairly large amount of deposition forty-five minutes after the injection; even this early, some non-opaque areas are dimly visible in the liver suggesting metastases. One and a quarter hours after the injection the film (Fig. 4) shows sufficient detail for a definite diagnosis of hepatic metastases, and the spleen is well demonstrated. One and three-quarter hours after

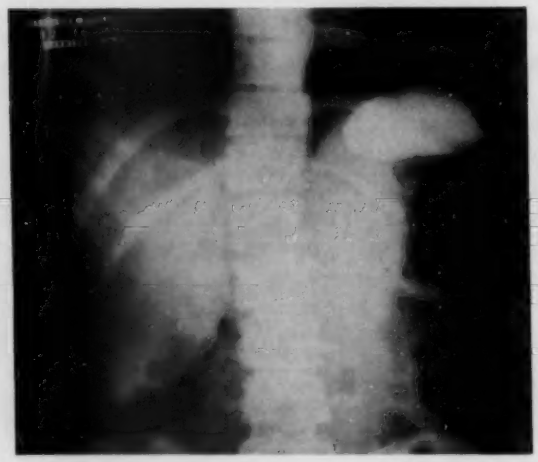

Fig. 5. Hepatospleogram made one hour and forty-five minutes after the injection. Slightly more definition than in Figure 4.

Fig. 6. Hepatosplenogram made seven hours and forty-five minutes after the injection. Maximum definition, but not much better than in Figure 5.

injection the film (Fig. 5) is excellent and practically as good as any made thereafter. Figure 6 shows the film made seven and three-quarter hours after the injection; apparently all of the thorotrast has now been taken up by the reticulo-endothelial cells. The film made the following day showed no greater density or detail except of the smaller left lobe of the liver.

CONCLUSIONS

1. Stabilized thorium dioxide (thorotrast, Heyden) may be injected without severe reaction in one total dosage of 0.5 c.c. for each pound of body weight of a patient up to 75 c.c.

2. The reticulo-endothelial cells in the liver and spleen engulf the contrast medium as early as fifteen minutes in sufficient amount to allow a shadow to be cast by these organs on the roentgenogram.

3. As early as one and a quarter hours after injection a fairly good idea of the characteristics of the liver and spleen may be obtained from the film.

4. One and three-quarter hours after the injection very good definition is observed, and films made any time thereafter show only slight improvement.

5. When haste is necessary for making diagnoses of hepatic or splenic disease, thorotrast can be injected in the total dosage at one sitting, and the film made two hours thereafter will give all of the information obtainable from a hepatosplenogram.

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ADOLESCENT SACROILIAC JOINTS

THEIR NORMAL DEVELOPMENT AND THEIR APPEARANCE IN EPIPHYSITIS*

By EDWIN N. CLEAVES, M.D.
BOSTON, MASSACHUSETTS

THE purpose of this paper is two-fold: (1) to describe the development of the sacroiliac joints; (2) to consider certain changes which sometimes occur during adolescence. These changes are in the nature of an epiphysitis, or subchondral necrosis. They are similar to the changes

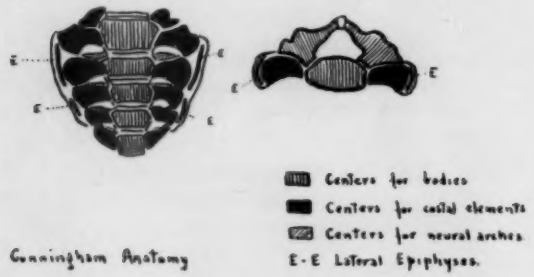


FIG. 1. Development of the sacrum. Diagram showing the centers of ossification of the sacrum. (Adapted from illustration in Cunningham's Anatomy.)

taking place in other parts of the body, and which have been described by Perthes, Osgood, Schlatter, Kienböck, and others. These changes have been called by a variety of names, such as epiphysitis, subchondral necrosis, osteochondritis of the growth centers, and so on.

I propose first to review briefly the development of the sacrum, laying emphasis upon the small ossification centers (epiphyses) which appear on the lateral masses of the sacrum. It is essential to recognize these small centers in order to interpret correctly roentgenograms of adolescent individuals.

As I have been especially interested in this subject for a number of years, I have been carrying on a study to determine the normal development. I chose a group of normal boys whose ages ranged from ten years to thirteen or fourteen years. I have taken stereoscopic roentgenograms of these boy's pelves every six months,—of some cases every three months. It is my belief that stereoscopic films are essential. A few of these boys are now nineteen years old, and their sacroiliac joints are, to all intents and purposes, fully developed.

The development of the sacrum is well explained in Cunningham's Anatomy,[2] to which I refer (Fig. 1). Each sacral segment is chiefly formed from a center for the body, two centers for the neural arch, and two for the costal elements. The centers for the bodies of the first three sacral segments appear about the third month; of the other segments, about the eighth month. The bodies are separated by epiphyseal plates, which after puberty fuse, producing union of the bodies. From the centers for the neural arch come the laminae, the articular processes and the posterior halves of the alae. These appear about the fifth or sixth month. From the centers for the costal elements come the anterior halves of the alae. The anterior and posterior halves of the alae fuse to form the lateral masses.

In addition to these chief centers, and I quote from Cunningham's Anatomy, "two thin osseous laminae are developed in the cartilage covering the lateral surfaces of the alar masses" (Figs. 2 and 3). These small centers described by Fawcett[3] in minute detail have been forgotten, or at least have been paid little attention. Fawcett pointed out that the transverse processes of the lumbar vertebrae represent a fusion of transverse and costal elements. Both of these elements have epiphyses on their tips, as Fawcett has demonstrated in anatomical specimens. In the sacrum, the anterior halves of the alae correspond to

* Read at the Thirty-sixth Annual Meeting, American Roentgen Ray Society, Atlantic City, N. J., Sept. 24-27, 1935.

the transverse processes of the lumbar vertebrae. As might be expected, corresponding epiphyses may also be demonstrated. On the transverse processes of the first sacral segment are easily distinguishable epiphyses. The other epiphyses of the transverse elements are smaller and less conspicuous, and cannot be differentiated roentgenologically. The "thin osseous laminae" mentioned by Cunningham are formed, according to Fawcett, by the fusion of the epiphyses of the costal elements of the sacral segments.

In the boys whom I have been observing, it has been very interesting to see these small epiphyses of the costal elements of the sacral segments appear, and later fuse to the margin of the sacrum. As a rule, they appear at about the fifteenth to eighteenth year, but I have seen them in a boy of thirteen. However, in this case, the other epiphyses were farther advanced than the age of the individual would indicate. These centers are usually fused by the nineteenth year. It is also interesting

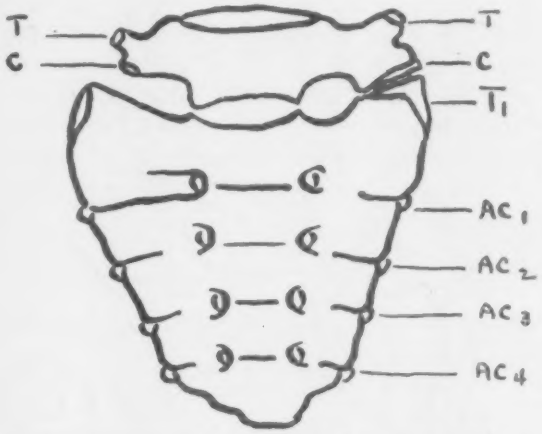


Fig. 2. Anteroposterior view of sacrum; patient, aged eighteen. The 5th lumbar vertebra and the sacrum from the front. On the left side, the fifth lumbar vertebra is in process of fusion with the first sacral vertebra. *T*, transverse process and epiphysis of fifth lumbar vertebra. *C*, costal process and epiphysis of the fifth lumbar vertebra. AC_1, anterior costal epiphysis of 1st sacral vertebra. AC_2, anterior costal epiphysis of 2nd sacral vertebra. AC_3, costal epiphysis of 3rd sacral vertebra. AC_4, costal epiphysis of 4th sacral vertebra. (From Fawcett.)[3]

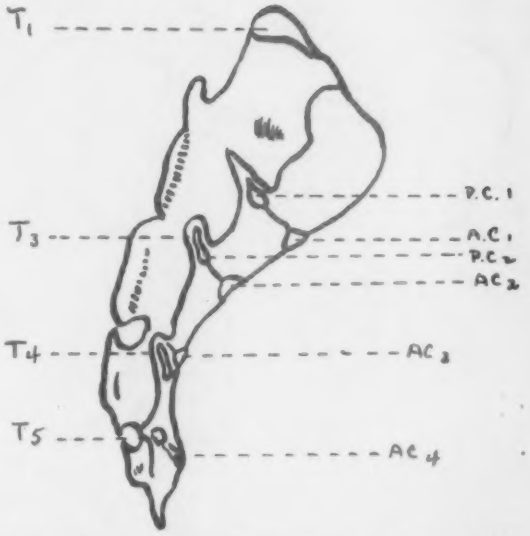


Fig. 3. Lateral view of sacrum; patient, aged eighteen. The sacrum viewed from the right side. AC_1, anterior costal epiphysis of 1st sacral vertebra. PC_1, posterior costal epiphysis of 1st sacral vertebra. AC_2, anterior costal epiphysis of 2nd sacral vertebra. AC_3, costal epiphysis of 3rd sacral vertebra. AC_4, costal epiphysis of 4th sacral vertebra. T_1, epiphysis of transverse process of 1st sacral vertebra. T_3, epiphysis of transverse process of 3rd sacral vertebra. T_4, epiphysis of transverse process of 4th sacral vertebra. T_5, epiphysis of transverse process of 5th sacral vertebra. (From Fawcett.)[3]

to note that just before they appear, epiphyses can usually be seen on the transverse processes of the first sacral segment, and also on the transverse processes of the lumbar vertebrae. We are able to demonstrate roentgenologically nearly all of the epiphyses described in Fawcett's anatomical observations (Fig. 4).

Ossification of the Sacrum (Human)

Cunningham			Fawcett		
CenTra	1st	5	Primary CenTres	CenTra	5
Neural Arches	2nd–5th	10		Neural Arches	10
Costal processes	2nd–5th	8 or 6		Costal Processes	8 or 6
Epiphyseal plates of CenTra	2nd–5th	10	Epiphyseal plates of CenTra	2nd–5th	10
Alar or lateral Masses	2nd	2	Costal processes	2nd	2
Tubercles	3rd	2	Transverse processes	3rd–5th	8
Total		37 or 35	Mammillary processes	1st	2
			Spinous processes	1st–3rd	3
			Total		58 or 56

Fig. 4. Table showing the ossification of the sacrum. (Taken from Fawcett.)[3]

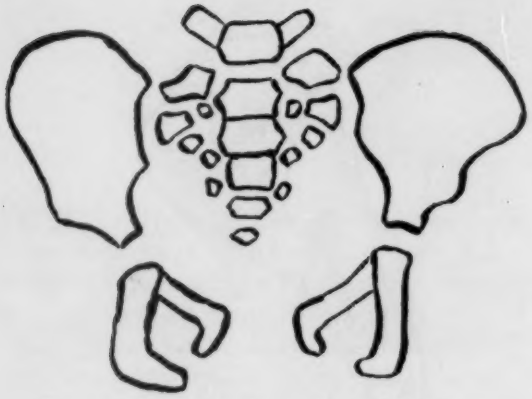


FIG. 5. Diagrammatic tracing of the sacrum of a child shortly after birth.

So much for a review of the development of the sacrum, and now let us turn to the sacroiliac joints, as seen by the roentgenologist.

In the first year, the sacroiliac joints appear as two fissures between the lateral masses of the sacrum and the ilia. The fissures are wider at the bottom than at the top. At this time, the posterior mar-

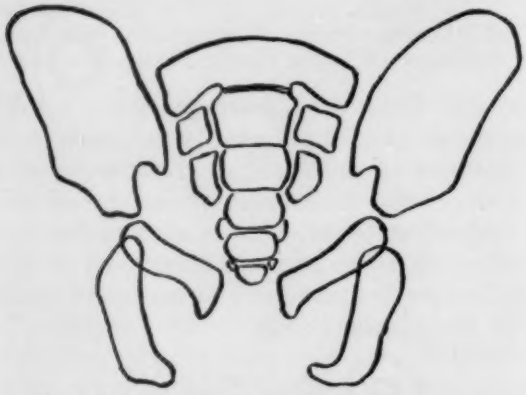


FIG. 6. Diagrammatic tracing of the sacrum of a child of four months.

gins of the joint are directly behind the anterior margins, consequently their shadows are superimposed, and only a single set of joint lines can be seen (Figs. 5, 6, 7 and 8).

At four years, the fissures representing the sacroiliac joints are a little narrower, diverging perhaps slightly from above downward. The posterior margins of the sacral sides of the sacroiliac joints are still directly behind the anterior margins; consequently their shadows are still superimposed.

At fifteen to eighteen years, real changes take place (Figs. 9, 10, 11 and 12). At this stage, the picture often becomes confusing. It is at this time that the ossification centers begin to develop in the cartilage on the lateral masses of the sacrum. As these centers develop, they are seen projecting

FIG. 7. Diagrammatic tracing of the sacrum of a child of six years. *AM*, anterior joint margins. *PM*, posterior joint margins. Note wide joint space.

into the joint spaces. Inasmuch as they are rather irregular in shape, the anterior joint margin on the sacral side is less distinct, and the joint space is irregularly narrowed. I believe that these centers develop chiefly on the anterior margins of the

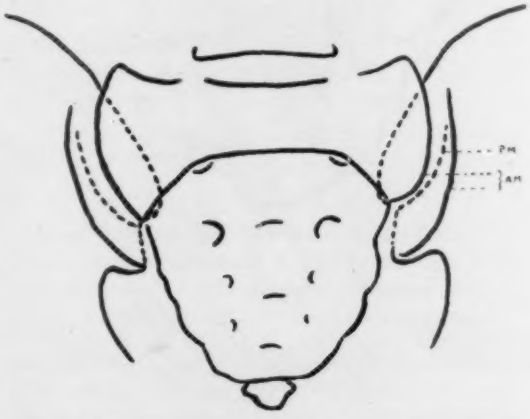
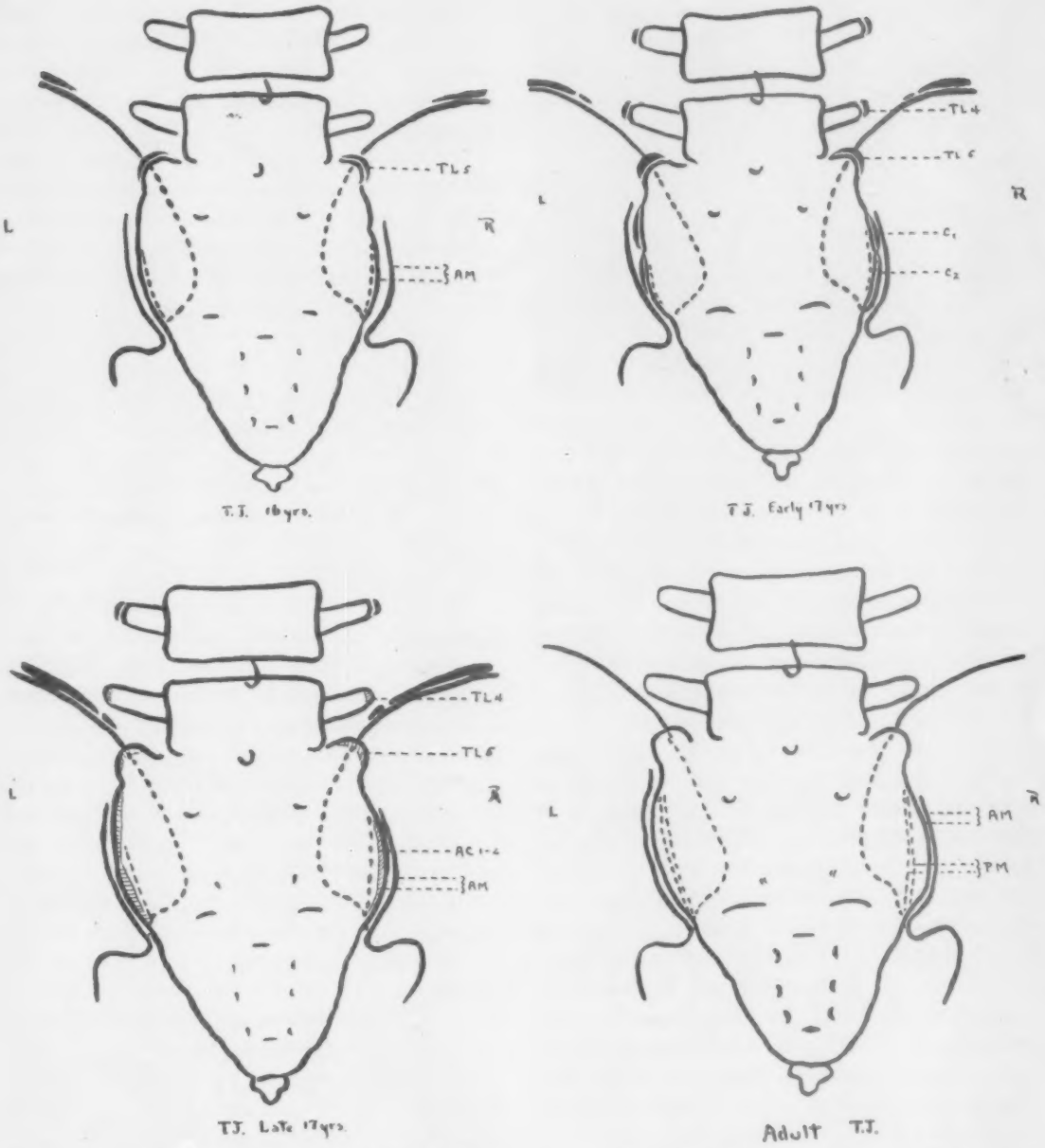


FIG. 8. Diagrammatic tracing of the sacrum of a child of eleven years. *AM*, anterior joint margins. *PM*, posterior joint margin. Note wide joint space.



Figs. 9, 10, 11 and 12. Diagrammatic tracings of the sacrum of a male from sixteen years to adult age. In this case there is a sacralized 5th lumbar. TL_4, epiphysis of transverse process of the 4th lumbar vertebra. TL_5, epiphysis of transverse process of the 5th lumbar vertebra. C_1, C_2, epiphyses of costal processes of 1st and 2nd sacral vertebrae. *AM*, anterior margins of the sacroiliac joints. *PM*, posterior margins of the sacroiliac joints.

joints, thus widening the anterior surface of the sacrum. As the anterior surface of the sacrum widens, the posterior margins of the sacral side of the joint begin to be visible in an anteroposterior view of the pelvis. The anterior and posterior margins on the ilial side of the joints seem to close in and narrow the joint space slightly.

At about nineteen or twenty years, the ossification centers on the lateral masses of the sacrum (epiphyses) are usually completely formed and united with the sac-

rum. It is at this time that both anterior and posterior margins of the joints can be well distinguished. The posterior joint margins are seen mesial to the anterior margins, due in part to the widened anterior surface of the sacrum. The joint spaces are narrow as seen in the well-recognized adult form.

Now with the normal picture in mind, let us consider the picture seen in epiphysitis of the sacroiliac joint. Brailsford,[1] in his recent book, merely mentions this condition as occurring in the sacroiliac joints, but does not describe it. The general condition called epiphysitis was well summarized by Martin and Roesler.[4] They prefer to call the lesion "subchondral necrosis." In their paper, they correlate the pathological and roentgenological findings "in disease entities affecting the skeleton of young growing individuals," including conditions described by Perthes, Osgood, Schlatter, Köhler, Kienböck, and others.

In their Table 1, Martin and Roesler gave the pathological and roentgenological findings in "subchondral necrosis," as follows:

There is first microscopic evidence of necrosis without macroscopic changes in the shape or structure of the bone. Roentgenological findings are negative.

Then come intermeshing and fragmentation of the trabeculae associated with hemorrhage, compression and fracture. At this time, the roentgenogram shows haziness, fuzziness, sclerosis, condensation and irregularity of bone structure; then crumpling and crumbling, fragmentation and fracture; irregularity; deformity; flattening, cleaving and mushrooming.

Then follows absorption of bone detritus associated with cyst formation and sequestration. This is shown in the roentgenogram as cyst-like areas; areas of rarefaction; decalcification.

Then the final or healing stage, showing scar and callous tissue,—fibrous, cartilaginous and osteoid. This stage is shown in the roentgenogram by mottling and areas of decreased density, separation and cleavage; the bone may become normal in size, shape and structure. It may be associated with signs of arthritis. Pathologically the joint cartilage is not affected. In the roentgenogram the joint space is normal or increased in width.

Applying Martin and Roesler's description to epiphysitis—or subchondral necrosis—of the sacroiliac joints, we find haziness or fuzziness of the joints. The small epiphyses on the lateral masses show irregular areas of density, with distortion of their shapes, and even fragmentation. But there are no real areas of bone destruction in the joint margins. As healing takes place there may be bone production, but there is no fusion of the joints. It is interesting to note that the rami of the symphysis pubis are sometimes disaligned, suggesting abnormal mobility of one or both sacroiliac joints.

Clinically these cases are quite characteristic. The patient, of adolescent age, generally shows stiffness of the low back, with pain and tenderness over the sacroiliac joint, often with sciatic pain, and peculiar gait due to the loss of straight-leg raising. In severe types there may be a real protective list away from the side of the symptoms. On standing the motions are restricted, forward bending being limited, while lateral bending is more restricted on one side than on the other. On lying down, the straight-leg raising test is very much restricted with sciatic pain in severe cases. The whole picture is of such a type as is centered around one sacroiliac joint—tenderness, restriction of motion, and sciatic pain, which may be quite disabling, and which tends to recur on slight injuries or strain. In these cases it is difficult to trace back to any one definite injury. Some slight provocative strain during play is common, but not sufficient at first to create a definite impression. But once the symptoms start, repeated injuries aggravate the pain and stiffness. If these cases are given temporary rest (this usually means giving up athletics), and a supportive belt, their symptoms gradually disappear and remain in abeyance.

A typical case is that of P. K., one of the cases reported by Dr. M. H. Rogers and myself[5] (Figs. 13 and 14).

P. K., male, aged fifteen, a normal, well-developed boy, who was playing football with a high school team. There was no definite initial injury, but for about a month he had been having slight pain in his back and had been walking with a limp. His symptoms increased gradually and steadily, until any quick movement caused acute pain in his back and right leg. Physical examination showed a well built, stocky boy with quite limited straight-leg raising. There was tenderness over the right sacroiliac joint. A diagnosis of epiphysitis was made. The patient received very little treatment; his symptoms were relieved by simple protection. He was taken out of athletics. His symptoms disappeared rapidly, and now a year and a half later, he is perfectly well, and has never had any recurrence of his former trouble.

These cases must often be differentiated from infectious processes, especially tuberculosis. Tuberculosis of the sacroiliac joint is very rare, according to all authorities. It is associated with tuberculosis elsewhere in the body, and usually occurs as a part of a generalized tuberculosis. Epiphysitis is found, as a rule, in healthy, well-developed young persons who usually show no signs of active tuberculosis. The age of the patient is a help in diagnosis. I have never known of a definitely proved case of tuberculosis of the sacroiliac joint in a person under twenty years of age. Epiphysitis always occurs in persons under twenty years of age, that is, before the epiphyses are fully developed. Tuberculosis produces bone destruction while epiphysitis produces no bone destruction. Tuberculosis may show temporary improvement under rigid treatment, but recurrences take place, and if convalescence occurs, it is protracted and stormy. Epiphysitis responds in a relatively short period to mild protective treatment and does not recur.

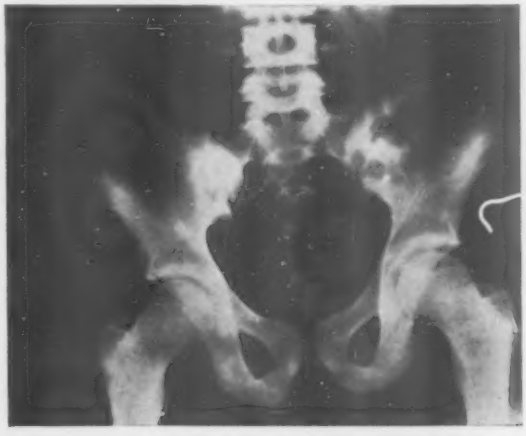


Fig. 13. Case P. K. During acute stage of epiphysitis.

Fig. 14. Case P. K. After complete recovery from epiphysitis.

In conclusion, I have reviewed the normal development of the sacrum and sacroiliac joints, emphasizing the small epiphyses which occur on the lateral masses of the sacrum. These epiphyses were described by an anatomist, Fawcett, a number of years ago; now they may be demonstrated in roentgenograms of normal, developing boys. These epiphyses, like epiphyses in other parts of the body, may manifest changes called by a variety of names, such as epiphysitis, subchondral necrosis, osteochondritis of the growth centers, and so on. Epiphysitis of the sacroiliac joint, producing as it does a rather definite clinical picture which Dr. Rogers and I have described as the adolescent sacroiliac joint syndrome, should always be borne in mind when an adolescent sacroiliac joint is being examined.

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DISCUSSION

DR. ARTHUR BRUCE GILL, Philadelphia. Dr. Cleaves and Dr. Rogers have opened up, to me at least, a very interesting subject and a new one. Since hearing Dr. Rogers' paper in Philadelphia last June, before the American Orthopedic Association, I have brooded over the question but haven't had an opportunity to pick up any of these cases. We will doubtless call on some of the members of this Society who live in Philadelphia to help us out in the diagnosis of these conditions.

When I first saw the title of Dr. Rogers' paper last June, I was a little inclined to be skeptical, but I am becoming more and more convinced that this is probably a true entity and that we will learn much more about it and see cases much more frequently now that we are looking for it.

The sacroiliac joint has to me, at least, always been somewhat difficult of diagnosis both clinically and roentgenologically. As Dr. Cleaves mentioned, the stereoscopic views are practically necessary in making a number of these diagnoses. This condition of osteochondritis, or epiphysitis, has, of course, occupied our attention for a good many years. Its etiology is still obscure; there is still diversity of opinion as to the cause of it. We must admit it occurs in epiphyses that are subject to a great deal of strain. I am willing to admit *a priori* if there is an epiphysis of the segment of the sacrum, it is the joint next above the hip joint which is subject to the body weight and strain of bodily activity.

I certainly feel very much indebted to Dr. Cleaves for this presentation. I would suggest to our roentgenologists, those with whom I have to deal at least, that it would be wise if we could have a series of films such as Dr. Cleaves has of the sacroiliac joint during its process of development so that we may be able to compare an individual case with this series. It is only by comparison that we can reach conclusions.

May I ask one question about the sacroiliac joint on which I am still in doubt? I have seen it stated that the sacroiliac joint fuses normally in the male in the fourth decade, before forty years of age; in the female, in the following decade. Is that true? I wish I could get an answer to that question. It is of tremendous importance. Many a diagnosis is made of arthritis where it may not be arthritis but merely the normal fusion.

DR. RALPH K. GHORMLEY, Rochester, Minn. My remarks would be almost identical with those of Dr. Gill. I first heard this presented at the orthopedic meeting in June. When I read the article, I was more impressed, and today I am still more impressed. I believe there is something very definite to be gained from this study. However, the problem of sacroiliac lesions in adolescents is a minor one compared to the problem in adults. We do see them and these are on the basis presented by Dr. Cleaves. I wonder if he can in any way trace any of the big problems of adult sacroiliac lesions to these disturbances in the epiphyses in adolescents.

DR. CLEAVES (closing). We think that some of the irregular, "queer-looking" sacroiliac joints, which are seen in adults, may be the end-result of early epiphysitis. So far as we have gone, we have no proof of this, and it is only a matter of conjecture.

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OSTEITIS FIBROSA CYSTICA DUE TO PARATHYROIDISM

By HENRY HIRSCH, M.D.
Roentgenologist, Fordham Hospital and St. Elizabeth's Hospital
NEW YORK CITY

THE diagnosis of osteitis fibrosa cystica is usually made by roentgen examination. It is divided into two groups: (1) the solitary type, and (2) the generalized type. This paper will discuss only the latter group, associated with hyperactivity of the parathyroid glands. The disease is presented from the standpoint of the roentgenographic changes as manifested in the long bones. Before attempting any description of osteitis fibrosa cystica generalisata, the question must first be answered, if possible, as to its etiology.

ETIOLOGY

The disease under discussion is caused by either a primary parathyroidism, or at least by overactivity of the parathyroid glands brought on by some special cause. It may occur at any age, in either sex, but is most common in women between thirty and sixty years of age.

PATHOLOGY

Hunter and others have shown that the parathyroid dysfunction may cause certain disturbances in the distribution and disposition of calcium. To understand the parathyroid disturbances, it is important to have the following basic facts in mind. If a parathyroid is irritated by hyperplasia, or by an adenoma, its function will be stimulated, so that more parathormone will be in circulation, leading to the following pathological changes:

1. *Biochemical.* Overactivity of the parathyroid produces an increase in the calcium in the blood, diminution of the phosphorus in the blood, and increased elimination of calcium and phosphorus by the kidneys.

2. *Roentgenological.* By the decalcification of the bony framework; these changes shall be discussed later.

3. *Changes in the Muscular Tone.* Muscular weakness.

4. *Secondary calcium deposits,* such as those occurring along the vertebral ligaments, intervertebral discs, blood vessels and kidneys. Because of the large excretion of calcium and phosphorus in the urine, kidney stones are formed. The bones show decalcification and cyst formation, are soft and can be cut with a knife. The microscopic appearance from the cystic area is that of a giant cell tumor. Abnormal deposits of calcium salts occur in the soft tissues.

5. *Morphological.* Parathyroid tumors vary in size, from that of an almond to a walnut. The growths are encapsulated, having a smooth contour, and microscopically show an adenomatous structure. Degenerative changes within the tumor are frequently observed.

SYMPTOMATOLOGY

The chief complaint is pain in the bones and joints followed by deformities. Often medical advice is sought because of a spontaneous fracture. There may be gastrointestinal disturbances, such as loss of appetite, nausea, and vomiting. There is a gradual progressive loss of weight, and secondary anemia. There may be a palpable tumor in the neck. Urinary symptoms are present, such as impairment of renal function, polyuria, low specific gravity, albumin and casts. Blood serum calcium is increased, and blood serum phosphorus is diminished.

ROENTGEN APPEARANCE

Skull. The calvarium is thickened. The larger blood vessel grooves are visible. The diploe are not visualized. The bones of the vault present a generalized, finely mottled

granular texture produced by areas of diminished density which are irregular in outline and of variable size. The bone between these areas is more dense than normal.

The *vertebrae* may or may not have narrowing of the bodies. The contour may be normal. The intervertebral discs appear to be normal. The bodies show decalcification replaced by multiple minute cystic areas of diminished density, producing a finely mottled appearance.

The *pelvis* may be the site of the most extensive bony changes in this disease. An extreme degree of decalcification is noted with replacement of normal bone structures by large and small trabeculated and nontrabeculated cystic areas associated with deformity. Slight trauma may result in fracture.

Ribs show generalized decalcification with thinning and expansion of the cortex.

Long bones show decalcification with replacement of the normal bone structures by large and small trabeculated and nontrabeculated cystic areas, with expansion and thinning of the cortex. No evidence of periosteal proliferation or invasion of soft tissues. Spontaneous fractures are common and tend to unite readily without excess callus. The healing process gives an appearance of increased density with loss of definition of outline.

Abdomen shows shadows of varying size in one or both lumbar regions, indicating renal calculi.

DIFFERENTIAL DIAGNOSIS

1. *Myeloma*, more common in males over forty years of age, medullary in origin and occurs simultaneously in different bones in the body, generally involves ribs, vertebrae, skull, sternum, clavicles. First the bones show expansion and later destruction of the cortex. The area involved is irregular in outline and is moth-eaten in appearance. The lesion is progressive and may have deformities due to fractures.

2. *Osteomalacia* generally occurs in adult females during pregnancy or during puerperium, and is chronic. In children, it is acute and serious; shows as a very thin indistinct shadow and appears almost translucent; very little contrast with soft parts. Bones are irregular in outline, angular, and generally show poor callus formation in case of fracture. Cortex is irregularly atrophied and the medulla is expanded. Skull is rarely affected.

3. *Osteitis deformans* occurs in middle life. The periosteum is irregular, cortex is thickened and furry. The medulla is narrow and the bone structure is of a patchy appearance, small cysts are present. Bones are deformed.

4. *Cancer*. Always metastatic, secondary to carcinoma of breast, prostate, thyroid, hypernephroma, lung, etc. It is medullary in origin, affecting the middle part of the shaft of the bone. The cortex is destroyed without any attempt at expansion. Tumor extends equally in all directions. Bones below the elbows and knees are rarely involved.

5. *Treatment* is surgical by removal of the parathyroid tumor. Medical treatment by administration of calcium and parathyroid extract has been found to be of no value. Roentgen therapy for the shrinkage of the adenoma has been tried and generally proved to be ineffectual.

End-Results. Immediate cessation of pain. Recalcification of bones begins about six weeks after the operation. The cysts solidify rapidly and the giant cell tumors are replaced by good osseous tissue. Symptoms of psychoneurosis often appear.*

REPORT OF CASE

J. T., aged forty-three; Austrian (Hebrew); occupation, salesman.

Patient was admitted to the hospital on February 14, 1934, complaining of pain in the right thigh and inability to walk. Says he felt something snap in the right thigh.

Family History. No history of familial disease.

* During the preparation of this paper, Dr. Richard Rendich, Director of the Division of Radiology in the Department of Hospitals, City of New York, stated to me that two of the cases at Kings County Hospital that were operated on for the removal of parathyroid tumor were followed by psychoneurotic symptoms.

Previous History. Patient bruised right leg two years ago, followed by a hard swelling, which in time became very painful. He was admitted for the first time to Morrisania City Hospital on October 5, 1931, complaining of a small, slowly growing, non-tender mass over the middle third of the right tibia. On October 8, 1931, patient left the hospital at his own request. He was readmitted on November 8, 1932, complaining of sacral pain which radiated down both legs and saying, in addition, that the mass on the right leg had been increasing in size. Physical examination showed some generalized tenderness over the sacrum; no limitation of motion, except flexion of the spine; some atrophy of the muscles of the right thigh, bilaterally diminished knee jerks; hyperalgesia of the lower sacral distribution on the right, and a non-tender, non-fluctuant mass over the middle third of the right tibia. Also gives a history of having had kidney stone ten years ago. No other past history. On November 25, 1932, the tumor mass on the right tibia in the middle third of the crest was removed. Lost about 30 pounds previous to the operation.

The pathological examination was reported as follows: Gross description: Fragments of spongy bone. Microscopic description: Bone fragments show a destructive process (loss of lamellae, decalcification, with osteoclasts, giant cells). Together with this, but to a less extent, new bone formation is present; osteoblasts are seen at the periphery of brightly acidophilic spicules of bone. Much osteoid tissue is present throughout, containing numerous giant cells. Tissue is richly vascular, with old as well as new blood. No evidence of the bone marrow is seen. Pathological diagnosis: These findings can be found in von Recklinghausen's disease (generalized osteitis fibrosa cystica) and also in giant cell tumor of bone.

The following laboratory data were also obtained: Blood Wassermann negative; repeated urinalyses showed trace of albumin and a few leukocytes. Bence-Jones protein negative. Blood chemistry: (11.17.32) calcium, 9.2 mg. per 100 c.c.; phosphorus, 4.1 mg. per 100 c.c.; (11.18.32) urea nitrogen, 20; sugar, 80; (12.12.32) calcium, 8.2 mg. per 100 c.c.; phosphorus, 4.9 mg. per 100 c.c.

Recovery was satisfactory and on December 15, 1932, the patient was discharged and instructed to return to the clinic.

Present History. Patient walking about since operation. Well up to three days ago when he felt something snap in the right thigh and could not walk thereafter. Previous to this had been having severe pain.

Physical Examination. Head, negative; chest, clear; heart apex not palpable, heard best fifth intercostal space outside midclavicular line; regular sinus rhythm; abdomen, no palpable viscera, no tenderness; local, right thigh at the upper third presented tenderness and some swelling and deformity, cannot move the extremity.

Impression. Pathological fracture, right femur.

Patient was put in a Russell's balance traction. Traction removed on April 8, 1934, and leg immobilized with sand bags. Patient permitted wheel chair privilege and while being moved to wheel chair he re-fractured his thigh a little lower down on shaft.

April 25, 1934. Buck's extension with a Thomas splint was applied with slight abduction using 7 lb. traction.

April 30, 1934. Patient out of bed, up and about on walking caliper, with minor complaints. He continued in this condition until September 12, when he twisted his left leg while walking into the bathroom. He was put to bed immediately and roentgenogram taken. This disclosed an incomplete fracture of upper third of left femur. Russell's balance traction was applied and patient remained in bed with traction until October 20. On October 24, a roentgenogram of the pelvis disclosed a pathological fracture of the superior ramus of the left os pubis.

Patient was operated upon on October 27, 1934, and an adenoma of the parathyroid gland which was found to extend from the posterior surface of the thyroid gland downward into the substernal region was removed. This was about the size of a lemon. Patient made uneventful recovery. Had a paralysis of the right vocal cord for a short time.

Pathological examination, on October 27, was reported as follows: *Gross:* The specimen consists of a tremendously enlarged parathyroid tumor mass weighing 24.5 grams. This mass is elliptical in shape, measuring 6.5 cm. in its long diameter, 4 cm. in its transverse diameter and 2 cm. in depth. Tumor is entirely encapsulated with a thin fibrous capsule. The surface of the gland presents a few small nodu-

Fig. 1

lar areas. Mass is rather firm in consistency and somewhat elastic. On cut section the mass presents a brownish appearance. There are several bands of fibrous tissue which traverse the tumor mass and produce a lobular appearance. There are several small areas on the surface which are spongy in consistency and contain small cystic dilatations. In addition there are a few small calcified areas scattered here and there. *Microscopic:* On histological section the capsule is found to be made up of several layers of densely packed acellular collagenous bundles. Examination of various sections taken through different parts of the tumor mass show that the predominating cell type is a large cell containing small, dark-staining eccentrically placed nucleus. Cytoplasm appears water clear on section. Numerous thin fibrous septa are scattered throughout the cells and divide them into smaller masses. The nuclei are uniformly darkly stained and show some variation in size, but no mytotic figures are seen. The next abundant cell is the chief cell—a normal cell appearing in the parathyroid gland. These chief cells are arranged in cords and in masses. In some areas they are separated by small cystic areas containing a pink-staining homogeneous fluid. On some of the sections, many small cystic dilatations are seen. There was no histological evidence of malignancy. *Diagnosis:* Adenoma of the parathyroid gland.

January 3, 1935. Patient was permitted out of bed and thereafter was up and about with aid of crutches. Commencing about two months after the operation, patient began to have many vague complaints. These complaints became more and more frequent and more intensive in character until about the time when he was out of bed. He would then say in spite of the fact that he was walking, that he could not walk at all, that he was not going to get well, that he was out of his mind. He would throw himself out of bed and permit himself to fall flat on his face while walking. In spite of this, no further fractures of the bones occurred. Urinalyses were consistently negative for albumin and sugar, and microscopically showed the occasional presence of white blood cells.

Blood examination for calcium and phosphorus:

	mg.	mg.
2/20/34	11.2	3.0
4/8/34	10.2	3.0
4/23/34	9.5	3.6
5/31/34	15.4	3.0
7/2/34	14.8	3.0
10/30/34	10.5	3.5
11/23/34	10.1	2.6
1/11/35	10.6	3.0
2/6/35	10.5	2.5

Wassermann reaction was negative.
Roentgen Examinations.

Right Leg (Fig. 1). Lateral view, September 30, 1931, reveals an irregular area of osteo-

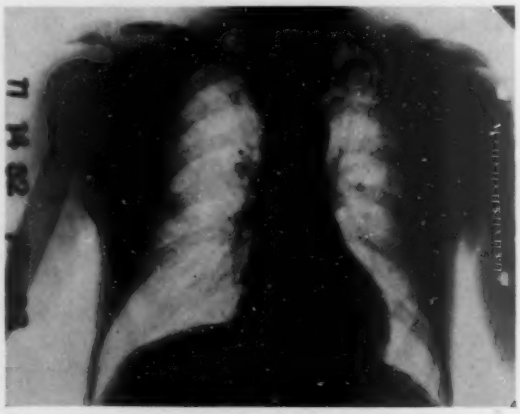

Fig. 2

porosis on the anterior aspect of the middle third of the shaft of the tibia. The bone shows circumscribed expansion with thinning of the cortex. Trabeculation is noted within the osteoporotic area. The lesion is limited to the cortex and the anterior part of the medulla.

Chest (Fig. 2). Roentgenogram taken on November 14, 1932, reveals a dense, circumscribed, homogeneous shadow with clearly defined border, slightly to the right of the median line. This shadow merges with the aortic arch shadow. Pulmonic markings in this area are obliterated. The remaining lung shows no definite pathology. Trachea slightly displaced to

Fig. 3

the left. *Diagnosis:* Intrathoracic thyroid. The left ninth rib in the midaxillary line shows an expansion and thinning of the cortex. The normal bone is decalcified and replaced by small trabeculated cystic areas. The left clavicle shows expansion and thinning of the cortex, and normal bone structures are decalcified and replaced by small trabeculated cystic areas, at the junction of the outer and middle thirds. Several small circumscribed areas of osteoporosis noted at the upper end of the diaphysis of the left humerus.

Right Femur (Fig. 3). Anteroposterior view, February 15, 1934, reveals thinning and expansion of cortex of the entire shaft, and sub-

Fig. 4

trochanteric pathological fracture. Normal bone is decalcified and replaced by large and small trabeculated cystic areas. Shaft shows increased outward bowing.

Left Femur (Fig. 4). Anteroposterior view, September 12, 1934, reveals expansion and

Fig. 5

FIG. 6

thinning of the cortex in the upper half. The normal bone structures show decalcification and are replaced by large and small trabeculated cystic areas. Incomplete, subtrochanteric pathological fracture is noted.

FIG. 7

Abdomen (Fig. 5). Roentgenogram taken on October 24, 1934, reveals the following: Several large and small irregular shaped shadows are noted in the right lumbar region and in the left lumbar region, indicating bilateral renal calculi. Right kidney appears to be normal in size, shape and position. Left kidney appears to be slightly enlarged. Anterior end of the left twelfth rib shows expansion and thinning of the cortex. The normal bone structures are decalcified and replaced by small trabeculated cystic areas. Lumbar spine shows narrowing and flattening of the bodies. Small irregular areas of osteoporosis and osteosclerosis are noted therein. The intervertebral discs and

FIG. 8

intervertebral spaces appear to be increased in width. No destructive lesion noted. Pelvis: Wing of the left ilium shows a large irregular area of osteoporosis in the upper part. Normal bone structures are replaced by large and small trabeculated cystic areas. Adjacent to the sacroiliac articulation, irregular areas of osteosclerosis noted. Iliac portion of the acetabulum shows several small circumscribed areas of osteoporosis with sclerosis of the surrounding bone. Similar processes seen in the right iliac bone, adjacent to the sacroiliac synchondrosis, and extending into the right wing of the sacrum.

Right Femur (Fig. 6). Anteroposterior view on October 24, 1934, reveals expansion and thinning of the cortex of the entire shaft. Nor-

mal bone structures are decalcified and replaced by large and small irregular trabeculated cystic areas. Subtrochanteric pathological fracture and a complete, irregular, transverse fracture at the junction of the upper and middle thirds are noted. The entire shaft shows an increased outward bowing. As compared with the examination made on February 15, 1934, lesion is progressing.

Left Femur (Fig. 7). The anteroposterior view, October 24, 1934, shows that the lesion is progressing, as compared with the examination made on September 12, 1934.

Right Femur (Fig. 8). The anteroposterior view January 7, 1935, reveals the decalcified shaft and the trabeculated cystic areas, previously reported, are replaced by marked calcification of bone. Multiple fractures have united with firm bony union. Upper half of the shaft shows marked outward bowing.

Left Femur (Fig. 9). The anteroposterior view, February 6, 1935, shows marked regeneration and calcification of the upper half of the shaft. The pathological fracture has united with firm bony union. Cystic area of the wing of the left ilium shows regeneration and calcification.

Right Leg (Fig. 10). The anteroposterior view, February 6, 1935, shows regeneration with calcification of the bone, and the bone structures appear to be normal.

Fig. 9

Fig. 10

Skull, both forearms and left leg showed no evidence of bone pathology.

Neurological Consultation. On February 9, 1935, cranial nerves, negative, except sluggishness. Left knee jerk diminished. Right, active. Weakness of the left quadriceps. Ankle jerk present. Negative Babinski. Patient groaning all the time. Says "What good is it to live?" Memory for recent events not good. Says he cannot concentrate. Suggest psychiatric observation. Patient transferred to Bellevue Hospital, February 12, 1935. Examination report from Bellevue Hospital is as follows: Superficially, the mental productions concerned hopelessness of his illness. He was agitated, crying, said he wanted to die, kept throwing himself about so that restraint was necessary, accused himself of making trouble for everyone about him. There was no history of a previous depression. Diagnosis: Psychosis with somatic disease—osteitis fibrosa cystica.

From Bellevue Hospital, the patient was transferred to the Rockland State Hospital, Orangeburg, N. Y. and was admitted on February 25, 1935. Diagnosis of his mental condition was psychoneurosis, reactive depression.

Patient died at the hospital on April 23, 1935. Cause of death: chronic myocarditis, with acute dilatation.

SUMMARY

1. The etiology, pathology, symptoms, differential diagnosis, treatment, and end-results of generalized osteitis fibrosa cystica associated with adenoma of the parathyroid gland have been presented.

2. Roentgen findings have been described from early stage to advanced stage.

3. Adenoma of the parathyroid was visualized on the roentgenogram of the chest. Even though a tumor cannot be palpated or visualized on the roentgenogram, if the patient presents the other roentgen, biochemical and urinary findings described, an exploratory operation is warranted.

4. Clinical and roentgen findings show improvement following a successful removal of parathyroid tumor.

5. Psychoneurotic symptoms followed the removal of the tumor in this case.

I wish to thank Dr. Edward R. Cunniffe, Director of the Second Surgical Division at Fordham Hospital, for permission to report this case.

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CINEFLUOROGRAPHY*

By W. H. STEWART, M.D., W. J. HOFFMAN, M.D., *and* F. H. GHISELIN, M.D.
Lenox Hill Hospital
NEW YORK CITY

CINEFLUOROGRAPHY, as the name indicates, is the making of a motion picture record of the image seen on the fluoroscopic screen. Attempts to accomplish this purpose were begun by McIntyre[6] in Glasgow soon after the discovery of the roentgen ray. These efforts met with little success, however, when applied to the living patient. In this country the late Dr. Eugene W. Caldwell conducted a series of such experiments beginning about 1908 and continuing for nearly fifteen years without any published success. Gastric motor phenomena were demonstrated more than twenty-five years ago by a motion picture film made from serial roentgenograms. In 1909, Kaestle, Rieder and Rosenthal[3] made thirteen successive roentgenograms of the stomach in twenty-two seconds. These were reproduced on a motion picture film, which, when projected, showed the passage of a peristaltic wave toward the pylorus. In 1910, Cole[1] demonstrated a method of making serial roentgenograms on a machine of his own design which employed a continuous roentgen film 8 inches wide and exposed areas of this film at regular intervals. When, by a reduction process, each of these roentgenograms was successively printed on a motion picture film, it was possible to project the film as a cinematogram. From 1921 to 1925 Reynolds,[4,5] of London, made extensive experiments leading at last to a successful motion picture of the fluoroscopic image of a thorax and various joints of the human body. More recently, Reynolds in England, Belot in Paris and Janker in Germany, employing greatly improved apparatus, have successively made motion pictures of the fluoroscopic image.

REQUIREMENTS OF THE PROBLEM

The recording on a motion picture film of the movements of organs and joints of the living human being is attended with considerable physical and mechanical difficulty. Any method which can be regarded as a solution of the problem must provide a technique which is safe, simple, convenient and inexpensive. Two methods may be suggested, namely, the direct and the indirect.

The direct method is the repeated exposure of any part of the human body to the roentgen beam recorded on a moving continuous roentgen film, as in the usual technique of making separate simple roentgenograms. This method is attended with many difficulties, is expensive and impracticable for routine examinations.

The indirect method makes a motion picture record of the fluoroscopic image. This method is obviously simpler, more accurate and less expensive.

DIFFICULTIES AND LIMITATIONS

Aside from the inherent mechanical difficulties, this method is restricted by definite physical limitations. In solving the problem, which, after all, is that of focusing the greatest amount of light on the most highly sensitive photographic film, the following factors govern the result:

(1) The amount of energy in the incident roentgen beam. This is limited by the capacity of the roentgen tube and by the tolerance of the patient's skin.

(2) The light-producing power of the fluoroscopic screen. This varies qualitatively and quantitatively according to:
   (a) The chemical composition of the screen.
   (b) The color of the fluorescence produced by the screen.

(3) The light-gathering power of the camera lens system.

* Read at the Thirty-seventh Annual Meeting, American Roentgen Ray Society, Cleveland, Ohio, Sept. 29–Oct. 2. 1936.

(4) The photographic sensitivity of the film as related to the fluorescence of the screen.

As the limits of each of the above factors are broadened, the greater is the scope of the method and the greater is the chance of success.

Roentgen Tube. The tube we have found most satisfactory for this purpose is the G. E. 10 R. W. This tube can be safely operated at 100 kv. with a current of 125 ma. for five seconds.

Skin Tolerance. When this tube is operated at 100 kv., 125 ma., at 40 cm. target-skin distance, with 1 mm. of aluminum and 5 mm. of wood filter, the estimated dose of radiation reaching the patient's skin is 500 roentgens per minute. This would be sufficient to produce an erythema in forty-eight seconds. The average time for each simple exposure has been five seconds and thus is well within the limits of safety. It is therefore apparent that the capacity of the roentgen tube is much more of a limiting factor than is the tolerance of the patient's skin. If it were necessary, however, a further reduction in the amount of exposure of the patient could be brought about by synchronizing the excitation of the roentgen tube with the camera shutter so that the roentgen rays strike the patient only during those instants when the camera shutter is open. Although this is the arrangement employed by Reynolds,[6] we have not found it necessary because in five seconds a complete cycle of any moving organ of the body except the stomach can be recorded.

Screen-Film Combination. It is impossible to consider the film and screen separately because both must be associated on the basis of two variables; likewise the photographic film reacts not only to the intensity of the light but to the color as well. Similarly, individual types of screens emit light of different color as well as of different intensity. In our experiments we have found the most satisfactory combination to be that of Eastman Panchromatic Super X Film used in conjunction with a special yellow green zinc sulphide fluoroscopic screen developed by Dr. Levy and Mr. West of London.

Lens System. The lens employed is a Zeiss Biotar with an aperture of 0.85 and a focal length of 5.5 cm. In order to cover a fluoroscopic field of 30×50 cm. it is necessary to place the lens at a distance of 7 feet from the screen. This lens is fitted with a focusing mount and because it is used wide open no diaphragm is employed.

Camera. The Zeiss Biotar was used in conjunction with the Bell and Howell Filmo 70-D, 16 mm. camera, fitted with a special finder.

Technique. Employing the above-mentioned factors and the normal camera speed of sixteen frames per second, eighty pictures could be obtained in the exposure time of five seconds. This is sufficient to record the motions of such rapidly moving organs as the heart, lungs and diaphragm, as well as to demonstrate the mechanism of swallowing. Films made of the thoracic viscera at this speed show normally exposed and clear-cut images which, when projected, reveal smooth motion at a normal rate. The chest walls of large patients with heavy muscular development are more opaque than average and the resulting films may be under-exposed. If the camera speed is reduced to eight frames per second, the exposure time per picture is doubled and a clear-cut properly exposed picture can thus be obtained. The apparent motion of the organs, however, is proportionately increased to twice the normal speed.

In suitably thin patients the camera speed may be increased to twenty-four pictures per second, so that when the film is projected the apparent motion is slowed down proportionately, and permits more careful study and analysis of the film. Within narrow limits the speed of the apparent motion may be further diminished by reducing the rate of projection. Beyond this point, however, further slowing of the projection speed produces a flickering image.

CINEFLUOROGRAPHY BELOW THE DIAPHRAGM

The investigation of the organs below the diaphragm is attended with greater difficulty. This portion of the body is so opaque that the fluoroscopic image is much fainter than that seen in the examination of the chest. Since the total time of exposure cannot be extended beyond a maximum of five seconds with the tube which we are using, the only way to increase the exposure per picture is to diminish the distance between the screen and the film and to reduce the camera speed to eight frames per second. At this rate, a clear picture can be obtained in a suitably thin patient. The time required for a normal peristaltic wave to pass downward along the full extent of the stomach has been estimated as averaging about forty-five seconds. For that reason even a five-second exposure is not likely to record much movement. It is in this region that the use of an interrupting switch synchronized with the camera shutter and the roentgen tube, by cutting off the beam when the shutter is closed, might aid by permitting a longer and interrupted exposure.

In an effort to obtain a film of the gastrointestinal tract below the diaphragm, we have shortened the screen-lens distance to 5 feet and reduced the camera speed to four to eight frames per second. This has increased the amount of light which reaches the film from any unit area of the screen. With the shorter screen-lens distance the size of the field has necessarily been proportionately reduced so that only a part of the screen image can be photographed. It is therefore necessary to focus the camera accurately on the pathologic lesion. With this technique we cannot at this time report consistent success although some satisfactory films have been obtained in average individuals. These have been successful in demonstrating gastric and duodenal lesions although the phase of gastric activity revealed by the film is so short that little of the correct physiologic activity of the stomach or duodenum can be demonstrated.

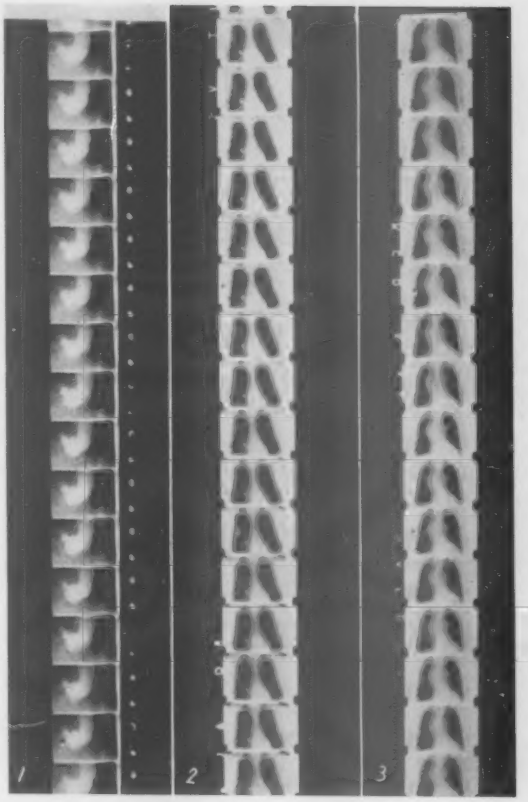

Fig. 1. Normal stomach.
Fig. 2. Bullet in the chest.
Fig. 3. Aneurysm of the arch of the aorta.

With the equipment and technique described above, we have been able to obtain excellent films of the action of the heart, lungs, diaphragm and esophagus. A single five-second, eighty-frame exposure is sufficient to record one complete respiratory cycle and two or three complete cardiac cycles. Films of the act of swallowing show the manipulation of the opaque bolus in the pharynx and its peristaltic descent through the esophagus. The entire action is contained on a strip of film containing twenty to forty frames, the projection of which would provide visible action for only a few seconds. By repeatedly printing this short film on a roll of film 25 feet in length or as long as desired, the cycles of action may be projected over and over

again for many minutes. This provides ample time for study of the physiologic action of the organs under investigation.

ADVANTAGES OF CINEFLUOROGRAPHY

By means of cinefluorography a permanent record may be made of the appearance and motion of functioning organs and parts such as the heart, lungs, diaphragm, esophagus, stomach and joints. By serial repeated printing on a continuous film the action may be projected for as long a time as desired. This motion picture record of the behavior of the organs can be studied at leisure indefinitely without danger of excessive exposure of the patient or the examiner. The permanent motion picture record provides a means of comparing the patient's condition or function with previous motion picture records, thus demonstrating the effects of treatment or the natural evolution of the disease process. It provides, therefore, a means for building up a library of excellent teaching material. These motion picture films can be shipped to distant places for consultation and opinion on the condition of the patient at the present time or at any time in his previous history as represented on the films.

The method is simple, convenient, safe and relatively inexpensive. With further experimentation and improvement, the scope of the method doubtless will be broadened.

FIELD FOR FURTHER IMPROVEMENT

At its present stage of development, the greatest needs in the field of cinefluorography are:

1. A method of prolonging the exposure so that a record of twenty to thirty seconds of action may be made at one time.
2. A more brilliant fluoroscopic screen.
3. Roentgen tubes of greater capacity for longer periods.
4. More sensitive films.
5. Better correspondence between the sensitivity of the film and the light production of the screen.

The first of these needs, namely, prolonging the exposure, could be met, at least partially, by exposing a single frame of motion picture film at relatively long intervals such as once per second. In this way, a strip of film containing thirty frames could be made in half a minute, long enough to trace a peristaltic wave over its full course throughout the stomach. We are now investigating this possibility, and will make it the subject of a future report.

Improvements in screen, roentgen tubes and films must await developments by the chemists and physicists. Until they are available we must learn to make the best possible use of the remarkable materials and equipment which they have already placed in our hands.

SUMMARY

Cinefluorography is the making of a motion picture record of the image seen on the fluoroscopic screen.

The patient is placed behind the fluoroscopic screen as in the ordinary fluoroscopic examination. The screen image is photographed by a motion picture camera equipped with a special lens.

The method is particularly effective in recording the action of the heart, lungs, esophagus, diaphragm and joints. Because of physical limitations it is less successful in slow-moving organs such as those located below the diaphragm.

Cinefluorography furnishes a permanent record of the function and motion of a part and permits a leisurely study of this record without danger to the patient or the examiner. This record can be compared with previous films to show the progress of the condition. It may be sent to a distant consultant for opinion. A collection of such film records provides valuable teaching material. It is probably destined to become an important division of roentgenological investigation and diagnosis.

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DISCUSSION

Dr. Lewis Gregory Cole, New York City. I think the Society is to be congratulated on the presentation of this moving picture representation of the fluoroscopic screen. It certainly is the last word in this particular method of approach to this subject which has intermittently interested many of us, both in this country and abroad, for a much longer period of time than many of you suspect. In this case I have seen those films that were made. I knew of the existence of Caldwell's work. I believe it was limited to the bones of the hands. I saw the work of Kaye. I saw the work of Reynolds and Dauvillier, which was rather close to what Dr. Stewart has been able to show us today, but I think there is no question that he has carried the thing one step farther than some of our continental confrères.

This is an old subject. Some of you think I was a pioneer in it when in 1909 I used a continuous film and made a film and demonstrated it. Kaestle, Rieder and Rosenthal had done it before I had. They claimed that they were various phases of the same cycle, but I am reasonably certain that they weren't, and even some ten years before that Roux and Balthazard did it on animals. So that almost nothing is new.

There is one interesting piece of history that goes with the presentation to this Society in 1909. It might be of interest to some of you. At that time, as Dr. Stewart said, we made a series of films. They were various cycles assembled in the order of the progress of the waves. We reproduced them cinematographically and showed them at Detroit in 1910. Incidentally, that article was lost in publication for a period of eighteen months. Nobody could find it. But it was a strange thing that during that time some work was done and another article on this subject was published before that article was finally found. An interesting incident, but go back and look at the *American Quarterly of Roentgenology* for 1912 and you will find that it is true.

There was not much scientific information derived from that first presentation. There was one fundamental thing which will eventually go down in history as probably being one of the greatest accidents that I ever had. In the production of these films cinematographically we showed the black prints one after the other. For some reason—why it is not at all clear to me at the present time—we made cutouts of those in order that they might be thrown on the screen something like this exhibit we have out here. They were still photographs, but then I took those films and turned them hindside foremost so that we looked at the back of the card. That film turned backwards made me the father of all animation. This was the father of Felix the Cat, the grandfather of Mickey Mouse, the great, great grandfather of the Big Bad Wolf; and furthermore that film shown to this Society in Detroit prevented Bray and Pat Sullivan from getting a fundamental patent on animation, and it has thrown open to all people from that time to this the free use of animation without patents.

I didn't know it at the time. It wasn't until about four or five years later Lloyd wrote into the office and wanted to know why they ever used x-ray for animation. I said, "What do you mean by animation?" He said, "I guess you are not the man. We ran into the professional animators who did the work of animation, transmitting the x-ray films into animations which substituted ten-stage intervals between them."

One day Carpenter came in and he said, "Cole, a lawyer came in this morning."

I said, "What for?"

"Well," he said, "this patent question is up again. They think they can get a patent on the fundamental principles of animation. By any chance have you a record that this was shown in Detroit?"

We went down and got the transactions.

"By any chance have you got the original film?"

I didn't move three steps from where he was over to the cabinet, and there in a little, round tin disk was the original animated film.

EFFECTS OF ROENTGEN IRRADIATION ON TRICHINOSIS IN THE ALBINO RAT*

By JOSEPH E. SEMRAD
Loyola University
CHICAGO, ILLINOIS

ALTHOUGH a century has passed since Owen's (1835) description of *Trichinella spiralis*, the causative agent of trichinosis in man, no specific cure has as yet been found. Various methods have been employed in the treatment of trichinosis without conclusive therapeutic results. Scattered in the literature are reports of successful treatments, but the number of subjects receiving the treatment is too small for conclusive statements.

Attempts were first made to treat trichinosis with drugs, and a few physicians reported success in their treatment of isolated cases. Such drugs as calomel, neoarsphenamine, antimony potassium tartrate, novasurol, thymol, santonin, rivanol, sodium iodide, and gentian violet have been used; but Chükri (1930), Baudet (1931), Miller, McCoy and Bradford (1932), and others, using these drugs did not obtain any demonstrable therapeutic effects when treating trichinosis experimentally produced.

Salzer (1916) reported that in 24 rabbits suffering from trichinosis experimentally produced, convalescent serum had a curative effect within twenty-four hours, but Schwartz (1917), practically repeating Salzer's experiments, did not obtain positive results. It was believed by Hall and Wigdor (1918), and others, that the serum of an animal that has recovered from trichinosis would be of value in supplying ready-made antibodies to combat toxic trichinous products, but there is no experimental evidence to substantiate such a belief.

Tyzzer and Honeij (1916) treated trichinized mice with radium and reduced the degree of infestation only in those animals that had been irradiated two days after infestation. Schwartz (1921) exposed trichinous pork to varying dosages of roentgen rays and then fed the treated meat to white rats without producing infestation.

The intra-intestinal thermal method was employed by De Rivas (1927) in treating one case. Salt solution of a temperature of 45 to 47° C. was passed into the intestine by way of a duodenal tube for ten to fifteen minutes, and the acute symptoms rapidly subsided.

A survey of effects of irradiation on tissue has shown that physiologically active tissue is very susceptible; embryonic cells are more susceptible than adult cells, Packard (1931). It has been demonstrated that cells which are undergoing rapid division may be destroyed upon exposure, whereas the surrounding more or less inactive cells are almost unaffected. In the life cycle of the *Trichinella*, the larvae rapidly develop into adults which give birth to young in the intestine, all in a period of two to seven days. It is apparent that the cells of the parasite are undergoing very rapid division during this period; hence it is my belief that during this period the developmental rate could be checked or even stopped. In this work, I attempted to determine whether or not development of the *Trichinella* in the intestine of the experimental animal upon exposure to roentgen rays was retarded or terminated.

MATERIALS, APPARATUS AND METHODS

The roentgen machine and roentgenometer used were manufactured by the Standard X-ray Corporation. The roentgenometer was equipped with an ionization chamber which was constructed to be equivalent to a filter of 4 mm. of aluminum. The voltage was kept at 112 kv. (peak) as measured by a sphere gap. The machine

* This work was carried out under the direction of the late Franklin D. Barker, Northwestern University, Evanston, Illinois.

TABLE I

COMPARATIVE WEIGHTS IN GRAMS OF INFESTED AND NONINFESTED ANIMALS

Animal number	1st day before infestation	3rd day after infestation	10th day after infestation	17th day after infestation	24th day after infestation	31st day after infestation	Remarks
1	190	181	168	169	177	181	
2	194	190	180	171	168	170	
3	222	210	194	185	182	183	
4	210	206	200	200	197		Died 25th day
5	198	198	189	182	176	172	
6	181	174	140	132	121		Died 25th day
7	192	194	190	193	202	202	
		Controls					
8	229	233	239	244	242	253	
9	239	240	246	255	248	246	
10	262	253	254	265	272	282	
11	198	203	208	208	207	202	

was mechanically rectified for dosage. The roentgenometer reading was 3.2 during irradiation, which, by calculation, is equivalent to 0.6 r per second at the skin. The focal distance was 10 inches and the milliamperes through the tube were 5.

For all the experiments, the trichinae were obtained from trichinized rats which were killed, skinned, the viscera removed, and the whole carcass run through an ordinary meat grinder. The ground meat was placed in a vessel containing a digestive fluid which consisted of 0.5 per cent HCl and 1.0 per cent pepsin, in a ratio of 40 grams of meat to 1,000 c.c. of the fluid. The material was kept at a temperature of 37° C. for from ten to twelve hours, being stirred occasionally. In order to remove particles of bone, the mixture was filtered through a 20 per-inch wire screen into a large funnel, to the neck of which was attached a short rubber tube closed by a clamp. The larvae, which settled to the bottom, were removed, washed several times with warm water, and placed in a burette for concentration of the suspension. The number of larvae in 0.1 c.c. of the suspension was determined. The suspension was then diluted so that the desired number of larvae was present in 0.25 c.c. of the suspension. The desired number of trichinae was placed in a little cavity in a meatball which consisted of fresh pork to which was added a mixture of corn meal and flour to take up the excess moisture. The meatballs containing the trichinae were later fed to previously starved albino rats which served as experimental animals.

EFFECTS OF TRICHINOSIS ON THE ALBINO RAT

A preliminary experiment was made to determine the effects of trichinosis on the albino rat and also to determine whether or not all the rats would react similarly to the same degree of infestation. Seven white rats were fed approximately 5,000 trichinae and 4 rats were used as weight controls. There was no manifestation of symptoms of trichinosis until the third day after infestation when one rat developed a slight case of diarrhea. On the seventh day all but one had diarrhea, sore eyes, edematous face, nasal hemorrhages, showed loss in weight, and they all showed leukocytosis and high eosinophilia. Chart 1 indicates that there was a great loss in weight in the infested animals whereas the controls gained in weight. Table 1 shows the comparative weights in grams of the infested and noninfested animals. The table shows that in the controls the gain in weight was gradual though not constant. The fact that these rats were fully grown may account for the slight fluctuation. The greatest loss in weight occurred in those rats which

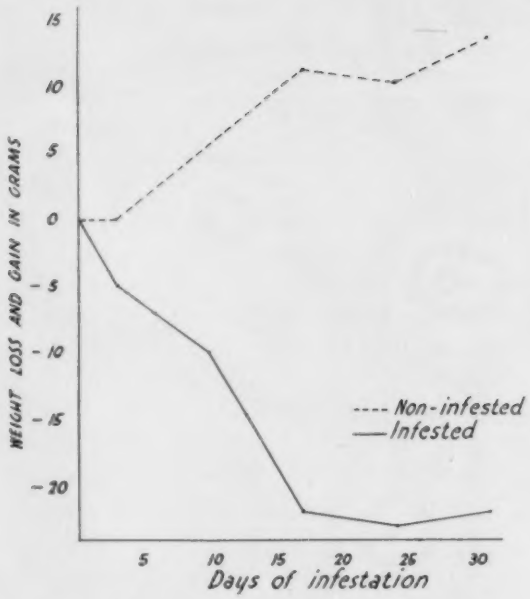

CHART 1. Summary of Table 1, showing average gain or loss in weight in grams of the group for a period of thirty-one days.

showed the most severe symptoms. It was shown that the degree of loss in weight is indicative of the severity of the disease and that some rats are less resistant to the disease than others. This is in accord with the work of McCoy (1931) who reported that 40 larvae per gram weight of rat caused death in twelve to thirty-five days. The fact, held by some, that the more resistant animals eliminated the trichinae much more readily than the less resistant, was not borne out in this experiment as the musculature was heavily infested in all cases.

EFFECTS OF ROENTGEN RAYS ON *Trichinella* IN VITRO

Trichinella larvae were liberated from rat musculature by the digestive method and the released larvae were given varying doses of roentgen rays. The trichinae were put in a celluloid dish that was placed on a lead base which absorbed the rays that penetrated the dish and thus prevented scattering. The dosages given were 400, 800, 1,200, 1,600, and 2,000 r.

The irradiated trichinae were fed to albino rats and effects noted. Noninfested rats and rats infested with normal trichinae served as controls against which weights and symptoms were checked. Twenty-eight rats were used in the experiment, and each rat was infested with 1,000 trichinae.

The rats fed trichinae irradiated with 400 r developed symptoms comparable to those of the rats infested with nonirradiated trichinae. Rats infested with trichinae subjected to larger doses of roentgen rays did not show any symptoms. Table II shows that during the premigratory stage the gain in weight for all the groups was about the same, the average being 4 grams during the three-day period. The fact that those fed trichinae exposed to 400 r did not gain in weight is not of significance. Throughout the experiment, those fed larvae exposed to 800 r or more gained in weight proportionate to the gain in the normal controls, whereas those fed larvae exposed to 400 r gained much less, especially during the early stages of the disease, but markedly more than the infested

TABLE II

AVERAGE GAIN IN WEIGHT IN GRAMS FOR GROUPS OF ALBINO RATS INFESTED WITH 1,000 TRICHINAE WHICH WERE IRRADIATED WITH VARYING DOSAGES OF ROENTGEN RAYS

Days after infestation	Average gain in weight in grams for groups						
	Infested controls	400 r	800 r	1,200 r	1,600 r	2,000 r	Normal controls
3	3	0	4	2	4	4	4
10	3	7	18	16	25	21	24
17	10	15	32	27	34	29	35
24	17	23	40	37	39	33	43
52	36	43	71	69	69	57	77

TABLE III

LEUKOCYTE COUNTS OF TRICHINIZED ALBINO RATS TREATED WITH ROENTGEN RAYS

Animal number	Number of worms infested with	Dosage of x-rays	Time of x-ray treatment	Leukocyte count days following infestation												
				Normal	1st day	3rd day	5th day	8th day	10th day	14th day	17th day	21st day	24th day	28th day	35 th day	38th day
61	3000	1000 r	3rd day	9,770	9,600	18,250	10,450	Died								
62	3000	1000 r	3rd day	10,000	10,900	16,250	5,200	2,950	Died							
63	3000	1000 r	3rd day	10,600	12,750	21,000	7,250	Died								
64	3000	1000 r	3rd day	9,830	10,600	18,600	6,100	Died								
65	3000	1000 r	3rd day	9,400	11,400	19,200	4,400	Died								
66	3000	1000 r	3rd day	10,800	11,400	17,050	5,600	Died								
73	—	1000 r	3rd day	9,500	7,050	14,900	6,200	Died								
74	—	1000 r	3rd day	11,500	10,300	15,300	2,450	1,900	Died							
75	—	1000 r	3rd day	9,500	6,150	15,150	3,350	Died								
76	—	1000 r	3rd day	10,000	9,800	15,500	5,100	Died								
77	3000	—	—	9,400	6,580	19,000	14,050	10,250	10,000	14,050	15,450	17,450	9,800	15,200	10,400	23,500
78	3000	—	—	8,500	7,900	16,000	16,950	11,300	7,570	11,950	12,300	11,450	9,850	12,400	14,450	19,550
79	3000	—	—	8,500	9,850	19,000	17,000	11,650	10,600	10,150	13,450	8,600	7,600	13,300	Died	
80	3000	—	—	8,700	7,500	18,950	14,300	10,850	13,720	17,250	15,500	17,200	13,200	13,900	14,350	15,250

TABLE IV

DIFFERENTIAL LEUKOCYTE COUNTS OF TRICHINIZED ALBINO RATS TREATED WITH ROENTGEN RAYS*

Animal number	Number of worms infested with	Dosage of x-rays	Time of x-ray treatment	Days following infection																																
				1			3			5			8			10			14			17			21			24			28			38		
				N	E	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	M	N	E	M
61	3000	1000 r	3rd day	48	8	44	61	18	21	10	90	0																								
62	3000	1000 r	3rd day	52	1	48	67	28	5	11	89	0																								
63	3000	1000 r	3rd day	50	3	47	81	14	5	10	90	0																								
64	3000	1000 r	3rd day	64	4	32	81	12	7	11	89	0																								
65	3000	1000 r	3rd day	62	0	48	82	15	3	12	87	1																								
66	3000	1000 r	3rd day	53	3	44	73	14	13	13	87	0																								
73	—	1000 r	3rd day	74	4	22	73	14	13	77	23	0																								
74	—	1000 r	3rd day	80	0	20	85	11	4	75	35	0																								
75	—	1000 r	3rd day	60	9	31	70	26	4	69	31	0																								
76	—	1000 r	3rd day	87	2	11	80	18	2	63	37	0																								
77	3000	—	—	94	3	3	72	24	4	61	33	6	79	17	4	58	35	7	90	9	1	78	18	4	81	13	6	83	14	3	76	4	20	82	12	6
78	3000	—	—	69	2	29	76	8	16	73	27	0	81	16	3	62	29	9	84	16	0	84	16	0	72	22	6	48	47	5	72	19	9	70	21	9
79	3000	—	—	58	12	30	81	19	0	72	27	1	81	16	3	70	25	5	85	12	3	80	18	2	81	16	3	75	18	7	67	20	13			
80	3000	—	—	91	1	8	87	10	3	67	31	2	75	16	9	70	29	1	84	10	6	76	23	1	79	13	8	62	18	20	59	22	19	66	19	15

* N—neutrophiles; E—eosinophiles; M—mononuclears.

controls. Table II indicates that at the onset of the migratory period the health of the animal was affected as there was no sign of a gain in weight in the infested controls, a slight gain in those fed larvae exposed to 400 r, and a large gain in all the other groups. Examination of gastrocnemius muscle revealed *Trichinella* larvae present in rats fed normal trichinae, those exposed to 400 r, and those exposed to 800 r, but none in those fed trichinae exposed to a higher dosage.

A comparison of the maximum number of trichinae in a single microscopic field (20×) of a piece of gastrocnemius muscle taken from rats fed trichinae exposed to 400 r with that taken from infested control rats revealed that the average number in the former group is 2.5 as compared with 8.2 for the latter. In the case of the rats fed trichinae exposed to 400 r, the largest number of larvae found in a single microscopic field was three and the smallest two. In the infested controls, the largest number of larvae found was eleven and the smallest five. In the case of the rats fed trichinae exposed to 800 r, the average number of larvae found was one with a maximum of two in the case of one rat. It is to be noted that the figures cited in each case are the greatest number it was possible to find in a single field.

It is quite clear that doses higher than 800 r render the *Trichinella* innocuous. The results show that even at an exposure of 400 r the larvae are attenuated.

EFFECTS OF LARGE DOSES OF ROENTGEN RAYS ON TRICHINOSIS

A series of 6 rats was given a single treatment with 1,000 r three days after infestation with 3,000 *Trichinella* larvae. Tables III and IV show the leukocyte picture which reveals that there was an average increase of 8,000 in the white blood count, and an increase in the eosinophiles to 15 per cent soon after irradiation. Two days after irradiation there was a general lowering of the leukocyte count to far below normal, accompanied by an increase in the eosinophiles to between 87 and 90 per cent, and a decrease in the lymphocytes to zero. This indicates that the eosinophiles are quite resistant to the action of the rays and that the lymphocytes are the least resistant, which is in accordance with the findings of Heinecke as far back as 1904.

A single roentgen treatment with 1,000 r proved fatal to the trichinized rats and also to the noninfested controls, which expired in three to five days following the treatment. In the noninfested irradiated controls there was also a leukocytosis following irradiation with a subsequent lowering of the white count, accompanied by an eosinophilia but no higher than 37 per cent. In the infested controls, on the third day following infestation, the leukocyte count had increased to an average of 19,000 and eosinophilia was from 8 to 24 per cent. The neutrophile count remained constant but the lymphocyte count decreased. There was a marked leukocytosis and eosinophilia throughout the study of these animals which extended over a period of thirty-eight days. The study was not continued long enough to determine the time required for the leukocyte count to return to normal. The great increase in the eosinophiles in the irradiated trichinized rats may be attributed to the fact that as the trichinae stimulated the increased production of leukocytes, especially eosinophiles, the roentgen rays exerted a destructive action on the leukocytes, the eosinophiles being the most resistant. Large doses of roentgen rays cause diarrhea, nasal hemorrhage, and a lowering of blood pressure, as evidenced by a shortage of blood in the tail region. The noninfested controls remained normal and healthy and gained in weight throughout the experiment.

EFFECTS OF SMALL DAILY DOSES OF ROENTGEN RAYS ON TRICHINOSIS

A series of rats was infested with 1,000 *Trichinella* larvae and the next day was subjected to 250 r as on subsequent days until the desired amount of radiation was

given. Five rats were given 1,000 r; five, 1,500 r; five, 2,000 r; and five, 2,250 r. A month after infestation the rats were killed and their diaphragms examined for trichinae. Pieces of diaphragm were pressed between two plates of glass and at least four fields were examined under 20× magnification. In the rats receiving 1,000 r, from 0 to 3 larvae were found in a single microscopic field. Sections of diaphragm 12 mm. square were examined and there were from 8 to 11 larvae present. In the rats receiving 1,500 r, from 0 to 1 larva was found in a single field. Pieces of diaphragm 12 mm. square were examined and there were from 5 to 7 larvae present. Of the 5 rats receiving 2,000 r only 2 survived; 3 died during the first thirteen days. Only 0 to 1 larva was found in a single field and 5 to 6 larvae were found in a piece of diaphragm 12 mm. square. Of the rats receiving 2,250 r only one survived. Only 0 to 1 larva was found in a single field and only 3 larvae were found in a piece of diaphragm 12 mm. square. In the infested controls, 3 to 11 larvae were found in the microscopic field and from 38 to 52 larvae were found in a piece of diaphragm 12 mm. square.

A study of Chart II reveals that in the case of the infested controls, an average of 43 larvae was present in a section of diaphragm 12 mm. square. The same size piece of diaphragm was checked in all cases. In those exposed to 1,000 r, 10 larvae were present; there were 6 larvae in those exposed to 1,500 r; 5.5 larvae in those exposed to 2,000 r, and 3 in those exposed to 2,250 r. It is readily seen that in those that were irradiated the total number of larvae was greatly reduced, the reduction being approximately 80 per cent.

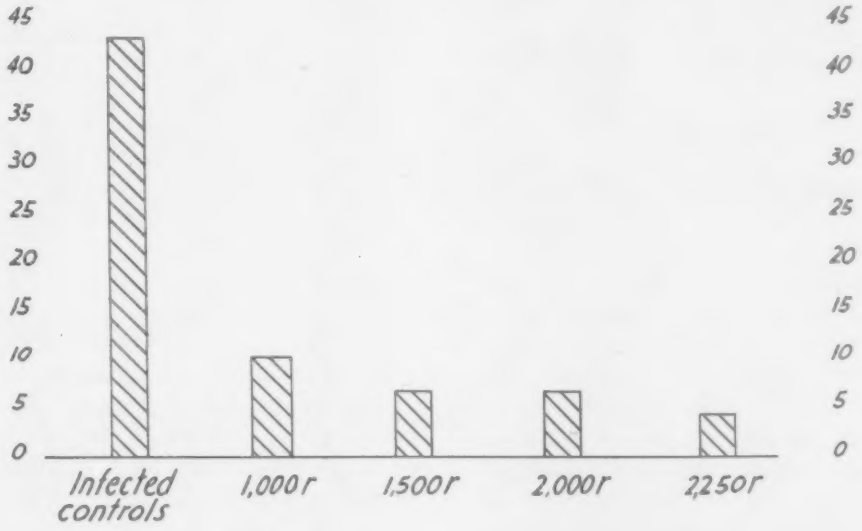

CHART II. The vertical columns indicate the average number of larvae in a piece of diaphragm 12 mm. square, taken from trichinized albino rats exposed to varying dosages of roentgen rays.

DISCUSSION

The degree of loss in weight is indicative of the severity of the disease. The rats that suffered the most had a decreased appetite which in a measure may account for the loss in weight. Some rats are more resistant to the disease than others. It has been suggested by McCoy (1932), and others, that the more resistant animals eliminate the trichinae much more readily than the less resistant, but that fact was

not borne out in the first experiment as the musculature was heavily infested in all cases. Fecal material obtained from trichinized rats that had been subjected to roentgen irradiation was observed. Samples were taken each day over a period of days but adult *Trichinella* were not observed in the feces even in those cases having severe diarrhea.

Trichinella in vitro will survive as great a dosage as 2,000 r given during a single exposure, but their generative powers are affected. Those receiving 1,200 r or more did not produce young. The generative powers of those exposed to 400 and 800 r were greatly weakened, the former by approximately 70 per cent, and the latter by approximately 85 per cent. This range is not in accordance with the data on effects of roentgen rays on the higher forms. In the higher forms the blood cells, the blood-forming organs, various glands, etc., are very susceptible to the action of the rays, as are the gonads. Of the very susceptible structures the *Trichinella* possesses only the gonads, and hence will remain alive even after exposure to large dosages of roentgen rays.

It was pointed out by Brown (1898) that during the stages of trichinosis there is a rise in the leukocyte count. Heinecke (1904), Morris (1905), Helber and Linser (1906), and others, pointed out that roentgen rays affect the white blood cells, resulting in a diminution in the total number. It was difficult to anticipate the results or effects when these two opposing factors were exerting their influence at the same time. Both factors, however, evidenced their influence. There was an early leukocytosis followed by an intense leukopenia. This is in accord with the findings of Morris (1905), who pointed out that preceding the leukopenia, there is a moderate rise in the number of leukocytes from eight to ten hours after the exposure, the increase being due largely to the greater number of polymorphonuclear cells in the circulation. Table IV shows a percentage increase in the neutrophiles and eosinophiles and a marked decrease in the lymphocytes. The neutrophile count dropped greatly two days following the roentgen treatment, being accompanied by a sharp increase in the eosinophile count. The eosinophile count increased even in the irradiated noninfested animals. It was conclusively demonstrated that the lymphocytes are very susceptible to the action of the rays, with the neutrophiles more resistant, and the eosinophiles very resistant. With the added stimulus, that is the presence of the trichinae in the body, the eosinophile count rose to as high as 90 per cent in the case of one animal.

Albino rats are not able to withstand a single dose of 1,000 r. They all succumbed within six days following exposure. However, some of the animals withstood as high as 2,250 r when given in daily doses of 250 r over a period of nine days.

The effects of roentgen rays are cumulative. The severity of the infestation decreased inversely with the increase in the dosage of the roentgen rays. Those receiving 1,000 r harbored 8 to 11 larvae in a piece of diaphragm 12 mm. square; those receiving 1,500 r harbored 5 to 7 larvae; those receiving 2,000 r harbored 5 to 6 larvae; those receiving 2,250 r harbored 3 larvae; while the untreated infested controls harbored 38 to 52 larvae. This demonstrates that roentgen irradiation in the treatment of trichinosis does have therapeutic value. It is believed that larger animals could better withstand the effects of roentgen rays as it would be possible to treat them from a different angle each day, and although the *Trichinella* in the intestine would be subjected to the same dosage, the different host tissues would be exposed to varying dosages, and perhaps not be so greatly injured.

SUMMARY

It was demonstrated that some rats are more resistant to trichinosis than others; also that the degree of loss in weight is indicative of the severity of the disease.

Trichinae show considerable variation in

their susceptibility to roentgen rays, since certain dosages injured some of the parasites but failed to injure others. Encysted *Trichinella* larvae in vitro, that have been exposed to 1,200 r or more, may continue development in the intestine of suitable hosts but they do not produce young. Experiments showed that even at an exposure of 400 r the resulting infestation is attenuated.

Trichinized as well as noninfested rats subjected to a single exposure of 1,000 r died three to five days following the exposure. There was a considerable loss in weight. In both cases there was a leukocytosis following irradiation with a subsequent lowering of the white count, accompanied by an eosinophilia. In the case of the infested, the eosinophilia reached as high as 90 per cent. The lymphocytes were reduced to zero in most cases and the neutrophiles also were greatly reduced.

Some of the trichinized rats were able to withstand 2,250 r when given in small doses over a period of nine days. That the effects of the roentgen rays are cumulative was evidenced by the fact that the severity of the infestation decreased inversely with the increase in the dosage of roentgen rays. In the animals that were irradiated the total number of larvae in the muscle was greatly reduced, the reduction being approximately 80 per cent.

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Twenty-third Annual Meeting, 1938: To be announced.

EDITORIAL

"MALIGNANCIES" AND CANCERS

Dorland's American Illustrated Medical Dictionary—Fifteenth Edition—W. B. Saunders Company, Philadelphia, 1929.

Malignant—Virulent, and tending to go from bad to worse.

Malignancy—A tendency to progress in virulence.

Gould's Medical Dictionary—Fourth Edition—P. Blakiston's Son & Co., Inc., Philadelphia, 1935.

Malignant—Virulent, compromising or threatening life.

Malignancy—The quality of being malignant.

Webster's New International Dictionary—India Paper Edition—G. & C. Merriam Company, Springfield, Mass., 1929.

Malignant—(1) Rebellious against God or against a Government; malcontent. (2) Tending or threatening to produce death; virulent; as malignant diphtheria, malignant tumor, etc. (3) Having a baleful influence; malign; malefic; as a malignant star or aspect. (4) Poisonous, deleterious; as malignant plants. (5) Disposed to do harm, inflict suffering, or cause distress; actuated or characterized by extreme malevolence of enmity; virulently inimical; bent on evil; malicious.

Malignancy—State or quality of being malignant. Med.-Virulence; tendency to a fatal issue, as the malignancy of a tumor.

SOME future medical historian will in all probability refer to the present era as being marked by a rapid growth in the general interest in cancer by both the medical profession and the general public. While on this subject, he might also comment on the prevalent curious tendency in medical writings and discussions toward circumlocution in substituting the euphemisms *malignancy* and *malignant disease* for the more direct and entirely adequate term *cancer*.

Even a cursory perusal of the current medical literature will reveal numerous references, both titular and textual, to "malignancies of the lip," "patients with malignancy," "the rôle of . . . in the origin of malignancy," etc. This tendency is carried to the extreme in such expressions as "the malignant prostate" and "the malignant breast." In a recently published article on one of the common anatomic forms of cancer, the term *malignancy* was used as a concrete noun in the title and in the text a total of 68 times, and the simpler and more direct *cancer* not even once. Some hospitals have "Committees on malignancy" or "Malignancy clinics." On the other hand, one may search in vain in the writings of the more enlightened or in such scholarly works as Ewing's "Neoplastic Diseases" for the use of the term *malignancy* as a concrete noun. One also will discover with some embarrassment that the lay press finds the term *cancer* not only necessary but entirely adequate, and avoids the ungrammatical *malignancy* and the ambiguous *malignant disease*. In a recent news item (*New York Herald Tribune*), we have noted the term "sarcoma" followed by the editorial explanation in parentheses as follows: "(a form of cancer)."

It is possible that this fault has its main origin in American English, but one must sadly confess that the term *malignancy* as a synonym for cancer also occurs in some of the leading English medical journals, and to escape the weight of such ponderous authority, we have but one refuge—the dictionary, and possibly that rare human quality—common sense.

The definitions which appear at the beginning of this article are representative of those found in all dictionaries, both stand-

ard and medical. From these definitions, what possible justification can there be for calling a cancer "a malignancy?" In short, the term *malignancy* is an abstraction expressing a state of being, and as such cannot correctly define a concrete object such as a cancerous growth. *Malignancy* is not *cancer*, but simply one of several qualities or tendencies, which it shares in common with many other diseases. Other well-known qualities, characteristics or tendencies of cancer are progressive growth, ulceration, induration, infiltration, the tendency to metastasize, painlessness and lack of tenderness in the early stages, and as a matter of fact, size, shape and color. Neither malignancy nor any one of the above-mentioned qualities is limited exclusively to cancer.

Neither is the use of the term *malignant disease* (without a definite antecedent) permissible as a synonym for cancer, since by correct definition, any disease is malignant which tends to go from bad to worse or to threaten life. Cancer is certainly a malignant disease, but it is not the only one, nor is it even the foremost. By restricting the quality of being *malignant* to cancer, all other diseases by inference become benign, including such correctives of overpopulation as bubonic plague and typhus, as well as that present-day major cause of death and therefore the most malignant of all—heart disease. Even the expression *malignant tumor* might be confusing without its proper context, for one must admit that an aneurysm of the aorta could be correctly included under such a classification. There have been periods in history when bubonic plague, typhus or even malaria were far more malignant than cancer, and there still remain areas on the earth where these diseases are of greater menace to life than any other.

Before going on to a discussion of the permissible definitive limits of these terms, it may be of interest to consider the reasons for and the probable origins of their common incorrect present-day usage in reference to cancer. The employment of a euphemism in referring to any serious or loathsome disease in the presence of an afflicted patient is no doubt as old as medicine itself, and for obvious reasons is both a psychologically sound and a humane practice. In tuberculosis, the significance of the initials "TB" has become so generally known that the original intent of concealment has been lost and it now serves simply as a convenient symbol. The circumlocution "acid fast infection" is often employed and still remains cryptic to the laity. In the case of venereal diseases, such synonyms or cryptic terms as "tripper," "g.c.," "Wassermann positive," etc., may serve to conceal from unauthorized ears such confidential data as may have some real or fancied moral implication. Except in cancer, however, such substitutes, symbols, contractions or slang terms, suitable only to informal discourse, have not been extended to common use in scientific writing and reporting.

At the present time, cancer is one of the foremost of the malignant diseases, ranking second only to heart disease as a cause of death. The malignancy of cancer is generally accepted by both the laity and the medical profession, and it is natural, therefore, that the physician in the presence of the afflicted patient or his family should tend to avoid the utterance of a term with such a connotation of hopelessness. The physician who is a practical psychologist realizes that even though the patient is fully aware of the real diagnosis, he fears and usually avoids the use of the term *cancer* as applied to his own case until assured of his ultimate recovery. But it would appear that the frequent necessity for such concealment by the physician eventually becomes habitual. As the result, we finally witness the curious spectacle of scientific men valiantly battling *cancer* as one of the foremost enemies of mankind, but so overcome by this tabu, that they address each other in scientific meetings and publish their observations in scientific journals without actually mentioning the scoundrel by name. This curious phenomenon might

be worthy of a more extended psychologic study than can be undertaken here. In the absence of an afflicted patient, if the subject under discussion is cancer, why not say so?

One encounters only a few minor difficulties and inconsistencies in advocating the inclusive use of the term *cancer* for all malignant growths. The term is derived from the Latin, meaning a crab. The expressions *canker*, *chancre* and *cancri* have the same common origin. *Carcinoma* (from the Greek *Karkinos*—crab) is an earlier term probably devised by the Hippocratic school. According to Robinson, the medical significance of these terms is explained by Galen—"Just as a crab's feet extend from every part of its body, so in this disease, the veins are distended, forming a similar figure," and by Paulus who repeats the comparison and adds—"But some say that cancer is so called because it adheres to any parts which it seizes upon in an obstinate manner like a crab."

In its medical sense, *cancer* remained for over twenty centuries as the inclusive expression for all malignant growths until the invention of the microscope made it possible to determine the intimate cellular nature of neoplasms and their tissues of origin. After that time, the term *carcinoma* became definitely associated with malignant tumors of epithelial origin in contradistinction to *sarcoma* indicating a tumor of mesodermal origin. Most of the other specific classifications devised since that time are named after the tissue of origin with the suffix *oma* (Gr—implying a morbid condition, especially a tumor), which provides for an ample nomenclature.

Etymologically, some confusion arises from the fact that *cancer* and *carcinoma* have a common definitive origin—one from the Latin, and the other from the Greek. To add to the confusion, the commonly used symbolic contraction *ca* fits either one equally well. Since malignant epithelial growths are preponderant, chance alone favors any cancer being of such origin, and therefore the latter term is often considered synonymous with carcinoma. Gould's Medical Dictionary (fourth edition) defines *cancer* as "Any kind of malignant growth." Stedman's Medical Dictionary (twelfth edition) leaves the decision to the reader, for it defines *cancer* both as "(1) Any malignant neoplasm" and "(2) Specifically carcinoma as distinguished from sarcoma." In Dorland's medical dictionary, there is also an apparent attempt to straddle the question, for after defining *cancer* as "a malignant tumor made up chiefly of epithelial cells," there follows a list of varieties which includes at least five clearly not of epithelial origin. Possibly some of the tendency toward the incorrect use of the word *malignancy* is that the term *cancer* is often mistakenly considered only in its restricted sense as applying to epithelial tumors. The term *cancer* as used in the titles of many leading cancer hospitals and national cancer journals is certainly not intended to be synonymous until *carcinoma*, as for instance, The American Society for the Control of Cancer does not limit its activities to the control of carcinoma.

A consummate example of absurdity is found in such expressions as "the malignant prostate" or "the malignant breast." Surely the breast itself can never be other than benign. Paradoxically, the prostate itself might possibly be spoken of as being *malignant* if it had undergone such marked benign hypertrophy as to endanger life, but when involved by cancer, surely it is not the prostate which is malignant but the cancer which develops within it. "Malignant thyroid" might be applied to severe hyperthyroidism, but hardly to cancer in that organ.

The remedy for these difficulties is simple. All medical journals exercise certain editorial privileges with submitted manuscripts. They might properly insist upon the terms *cancer*, *malignant neoplasm*, *malignant growth* or *malignant tumor*, at the same time rejecting both the use of *malignancy* as a concrete noun and the ambiguous expression *malignant dis-*

ease in referring to cancer. The number of permissible terms is sufficient to avoid alliteration (growth, tumor, lesion, disease, etc., are also permissible with proper antecedents and context).

There can be no question but that short all-inclusive word is needed to define malignant neoplastic diseases in general. There is at present none more readily available and already having the sanction of longer usage than the term *cancer* in its original broad, nonspecific meaning. One should not have to be an ardent philologist to find *malignancy* and *malignant disease* incorrect, inadequate and abhorrent when employed in this sense. And though we may admit that usage finally determines correct speech, and that words, meanings and modes of speech are devised faster than dictionaries and grammars can be written, still there must be some limit beyond which proper speech may not go. Traditionally, the profession of medicine has always been considered one of dignity, culture and learning, and it should be the duty and privilege of every physician to keep it so to the best of his ability.

Hayes E. Martin

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. E. P. Pendergrass, University Hospital, Philadelphia, Pa. Annual Meeting: Chicago, Ill., Sept. 13–17, 1937.

American College of Radiology
Secretary, Dr. E. L. Jenkinson, 1439 S. Michigan Ave., Chicago, Ill. Annual meeting: Chicago, Ill., September, 1937.

Section on Radiology, American Medical Association
Secretary, Dr. J. T. Murphy, 421 Michigan St., Toledo, Ohio. Annual meeting, 1938: To be announced.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N. Y. Annual meeting: Chicago, Ill., Sept. 13–17, 1937.

Radiological Section, Baltimore City Medical Society
Secretary, Dr. Howard H. Ashbury, Baltimore. Meets third Tuesday each month, September to May.

Radiological Section, Connecticut State Medical Society
Secretary, Dr. Max Climan, 242 Trumbull St., Hartford, Conn. Meets twice annually in May and September. Special meetings may be called by the Chairman.

Radiological Section, Los Angeles County Medical Society
Secretary, E. N. Liljedahl, Los Angeles, Calif. Meets on the second Wednesday of each month at the County Society Building.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Brooklyn Roentgen Ray Society
Secretary, Dr. E. Mendelson, 120 E. 19th St., Brooklyn, N. Y. Meets monthly on first Tuesday, October to April.

Buffalo Radiological Society
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St., Buffalo, N. Y. Meets second Monday of each month except during summer months, place of meeting selected by the host.

Chicago Roentgen Society
Secretary, Dr. R. G. Willy, 1138 N. Leavitt. Meets second Thursday of each month October to May inclusive at the Palmer House.

Cincinnati Radiological Society
Secretary, Dr. J. E. McCarthy, 707 Race St., Cincinnati, Ohio. Meets third Monday of each month, October to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. North W. Shetter, 14600 Detroit Ave. Meetings are held at 6:30 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

Denver Radiological Club
Secretary, Dr. N. B. Newcomer, 306 Republic Bldg., Denver, Colo.
Meets on the third Tuesday of each month.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne Country Medical Society Building.

Florida State Radiological Society
Secretary, Dr. Harold O. Brown, Tampa, Florida. Meetings held twice a year, May and November.

Illinois Radiological Society
Secretary, Dr. Cesare Gianturco, 602 W. University Ave., Urbana, Ill. Regular meetings held quarterly.

Indiana Roentgen Society
Secretary, Dr. C. C. Taylor, Indianapolis, Ind. Meeting held the second Sunday in May annually.

Long Island Radiological Society
Secretary, Dr. S. G. Schenck, 115 Eastern Parkway, Brooklyn, N. Y. Meets at Kings County Med. Soc. Bldg. on third Thursday of each month from October to May, at 8:30 P.M.

Michigan Association of Roentgenologists
Secretary, Dr. C. S. Davenport, St. Lawrence Hospital, Lansing, Mich. Three meetings a year, Fall, Winter, and Spring.

Milwaukee Roentgen Ray Society
Secretary, Dr. S. A. Morton, Columbia Hospital, Milwaukee, Wis. Meets monthly. Place of meeting named by the president.

Minnesota Radiological Society
Secretary, Dr. H. M. Weber, Mayo Clinic, Rochester, Minn.

Nebraska State Radiological Society
Secretary, Dr. D. A. Dowell, Medical Arts Bldg., Omaha, Nebr. Meets third Wednesday evening of each month.

New England Roentgen Ray Society
Secretary, Dr. E. C. Vogt, 300 Longwood Ave., Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

Radiological Society of New Jersey
Secretary, Dr. P. S. Avery, New Brunswick, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place designated by the president.

New York Roentgen Society
Secretary, Dr. R. W. Lewis, 140 E. 54th St., New York. Meets monthly on third Monday, New York Academy of Medicine, at 8:00 P.M.

North Carolina Roentgen Ray Society
Secretary, Dr. Major Fleming, Rocky Mount, N. C. Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

Central New York Roentgen Ray Society
Secretary, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse, N. Y. Three meetings a year—January, May, and November.

Pacific Roentgen Club
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. L. E. Wurster, 416 Pine St., Williamsport, Pa. Two day annual meeting, May, 1938. Exact date and place to be decided.

Philadelphia Roentgen Ray Society
Secretary, Dr. B. R. Young, Temple University Hospital. Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Camp C. Thomas, 476 Lake Ave. Meets on second Thursday from October to May, inclusive, 8 P.M., Rochester Academy of Medicine Building.

St. Louis Society of Radiologists
Secretary, Dr. W. K. Mueller, University Club Bldg., St. Louis, Mo. Meets fourth Wednesday of October, January, March and May, at a place designated by the President.

South Carolina X-Ray Society
Secretary, Dr. R. B. Taft, 105 Rutledge Ave., Charleston. Meets at time and place of South Carolina State Medical Association.

Tennessee Radiological Society
Secretary, Dr. F. B. Bogart, 311 Medical Arts Bldg.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. M. H. Glover, 414 Hamilton Bldg., Wichita Falls, Texas. Meets Nov. 20, 1937, in Dallas, at Adolphus Hotel.

UNIVERSITY OF MICHIGAN DEPARTMENT OF ROENTGENOLOGY STAFF MEETING
Secretary, Dr. C. B. Peirce, University Hospital, Ann Arbor, Mich. Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE
Secretary, Dr. F. A. Pohle, 1300 University Ave., Madison, Wis. Meets every Thursday from 4:00–5:00 P.M., Room 301, Service Memorial Institute.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. V. W. Archer, University Hospital, University, Va.
Meets annually in October.

CUBA

SOCIEDAD CUBANA DE RADIOLOGIA Y FISIOTERAPIA
Secretary, Dr. Francisco Padron, Enrique, Villuendas 64, Havana, Cuba. Meets monthly in Havana.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1, or as advertised.

SECTION OF RADIOLOGY OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8:15 P.M. at the Royal Society of Medicine, 1, Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Keith Hallam, St. George's Hospital, K.E.W., Melbourne, E. 4, Victoria, Australia. Meets monthly from March to Nov. incl. for scientific discussions.

CANADIAN ASSOCIATION OF RADIOLOGISTS
Secretary, Dr. A. C. Singleton, Medical Arts Bldg., Toronto, 5, Ontario.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. C. M. Jones, Inglis St., Ext., Halifax, N.S.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch. Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIEDAD ESPAÑOLA DE RADIOLOGIA Y ELECTROLOGIA
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7, Madrid, Spain. Meets monthly in Madrid.

SOCIÉTÉ DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

SOCIÉTÉ FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE
Meets monthly on fourth Tuesday, except during month of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, 11.52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SÜD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE
Secretary, Dr. Oscar Meller, Str. Banul Mărăcine, 30, S. I., Bucuresti, Roumania.
Meets second Monday in every month with the exception of July and August.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson, Meets annually.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly, first Monday at 8 o'clock State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. Jan. Kochanowski, 45 Gornoslazka St., Warsaw. Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with exception of the Denmark Society, meets every second month except in the summertime.

SOCIETY OF MEDICAL RADIOLOGY IN SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. G. Biering, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA ROENTGEN SOCIETY
Meets first Wednesday of each month, at 6.30 P.M. at Zentral-Röntgen Institut des allgemeinen Krankenhauses Alserstrasse 4.

ORIENT

JAPAN X-RAY ASSOCIATION
c/o Orthopedic Surgery, Tokyo Imperial University. Meets annually in April.

KINKI ROENTGEN-ABEND SOCIETY
Director, Dr. Prof. Taiga Saito, Ogawaoike Tyoto Japan. Meets bi-monthly on third Sunday.

PROVISIONS OF SOCIAL SECURITY ACT

Delinquent employers of persons working in private X-ray laboratories were advised today by Commissioner of Internal Revenue Guy T. Helvering to make immediate tax returns as required under the provisions of Titles VIII and IX of the Social Security Act to avoid further payment of drastic penalties which are now accruing.

Commissioner Helvering pointed out that every person working in private X-ray laboratories came under the provisions of Title VIII, which imposes an income tax on the wages of every taxable individual and an excise tax on the pay roll of every employer of one or more. This tax is payable monthly at the office of the Collector of Internal Revenue. The present rate for employer and employee alike is one per cent of the taxable wages paid and received.

Under Title IX of the Act, employers of eight or more persons must pay an excise tax on their annual pay roll. This tax went into effect on January 1, 1936, and tax payments were due from the employers, and the employers alone, at the office of the Collector of Internal Revenue on the first of this year. This tax is payable annually, although the employer may elect to pay it in regular quarterly installments.

The employer is held responsible for the collection of his employee's tax under Title VIII, the Commissioner explained, and is required to collect it when the wages are paid the employee, whether it be weekly or semi-monthly. Once the employer makes the one per cent deduction from the employee's pay, he becomes the custodian of Federal funds and must account for them to the Bureau of Internal Revenue.

This is done, Mr. Helvering said, when the employer makes out Treasury form SS-1, which, accompanied by the employee-employer tax, is filed during the month directly following the month in which the taxes were collected. All tax payments must be made at the office of the Collector of Internal Revenue in the district in which the employer's place of business is located.

Penalties for delinquencies are levied against the employer, not the employee, the Commissioner pointed out, and range from 5 per cent to 25 per cent of the tax due, depending on the period of delinquency. Criminal action may be taken against those who willfully refuse to pay their taxes.

The employers of one or more are also required to file Treasury forms SS-2 and SS-2a. Both are informational forms and must be filed at Collectors' offices not later than next July 31, covering the first six months of the year. After that they are to be filed at regular quarterly intervals. Form SS-2 will show all the taxable wages paid to all employees and SS-2a the taxable wages paid each employee.

Participation in a state unemployment compensation fund, approved by the Social Security Board, does not exempt employers from the excise tax under Title IX, Commissioner Helvering said. Nor does the fact that there is no state unemployment compensation fund relieve the employer of his Federal tax payments. In those states

Actual money, when paid as wages, is not the sole basis on which the tax is levied. Goods, clothing, lodging, if a part of compensation for services, are wages and a fair and reasonable value must be arrived at and become subject to the tax.

Commissions on sales, bonuses and premiums on insurance are wages and taxable.

Officers of corporations whether or not receiving compensation are considered employees for the purpose of taxation.

Wages paid during sick leave or vacation, or at dismissal are taxable.

Traveling expenses required by salesmen are not wages if the salesmen account for, by receipts or otherwise, their reasonable expenditures. That part for which no accounting is made is construed as a wage and is taxable.

Exercise great care in filling out Treasury forms SS-1 and 940. Directions are easy to follow and correct returns mean no unnecessary delay.

where an unemployment compensation fund has been approved, deductions up to 90 per cent of the Federal tax are allowed the employer who has already paid his state tax. These deductions are not allowed unless the state tax has been paid.

This tax is due in full from all employers in states having no approved fund. The rate for 1936 was one per cent of the total annual pay roll containing eight or more employees, and for 1937 it is two per cent. The rate increases to three per cent in 1938 when it reaches its maximum. The annual returns are made on Treasury form 940.

An employer who employs eight or more persons on each of twenty calendar days during a calendar year, each day being in a different calendar week, is liable to the tax. The same persons do not have to be employed during that period, nor do the hours of employment have to be the same.

BOOK REVIEWS

Books received are acknowledged under heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers as space permits.

Diagnostic Roentgenology. Ross Golden, M.D., Editor, Professor of Radiology, The College of Physicians and Surgeons, Columbia University; Director of the Department of Radiology, Presbyterian Hospital, New York. Cloth. Loose leaf. Price, $20.00. Pp. 854, with 964 illustrations. New York: Thomas Nelson and Sons, 1936.

This book is a new departure in American roentgenological literature, being made up of a series of eleven separate monographs by fifteen authors and co-authors, edited by Dr. Ross Golden, of the Presbyterian Hospital, New York. It is by far the most accurate and complete of any American textbook on roentgenological diagnosis and is well written on the whole, well printed, and well arranged. The various authors are outstanding men in their fields, with one or two exceptions, and there is very little overlapping of subject or context.

It seems to be the accepted custom for reviewers to find and point out as many mistakes as possible, scrutinizing the trees individually rather than the forest as a whole. But it will be our purpose to analyze the whole book and compare it with present textbooks and books of reference, with constructive criticism wherever possible. In general the book is an excellent one, good not only for the roentgenologist but also for the practitioner or specialist who is doing his own roentgenography or roentgenoscopy. On the other hand, it is too bulky and too comprehensive for the average medical student, and, even as big as it is (854) pages, is not complete enough to be called a book of reference to settle all problems of roentgenological diagnosis. It is a debatable question as to whether it would not have been better to publish individual monographs, making each one all-inclusive, as our specialty is changing rapidly and any textbook on roentgenology needs frequent revision. Several of the chapters could well be expanded into more complete and more detailed monographs. There are many physicians who are interested in only one phase of roentgen diagnosis who would like to have a complete reference monograph on that one subject alone and who would hesitate to purchase so expensive a textbook on the whole subject. However, that is a problem for the publisher who must have found a demand for such a book, and we may say again that it is the best book available in the English language on diagnostic roentgenology, even if it is too big for a textbook and too condensed for a reference book. It will be interesting to see how it is kept up to date, as is possible with the "loose-leaf" binding which is almost a Nelson specialty.

The introduction, written by Golden, sounds a note of conservatism and outlines an attitude which is highly commendable. It could well be printed as an annual editorial in our radiological journals as a declaration of principles which should be followed by all who are in this specialty. Golden is ably supported by "Forewords" written by Allen O. Whipple for surgery and W. W. Herrick for medicine, reflecting the high standing of roentgenology in the Presbyterian Hospital and The College of Physicians and Surgeons of Columbia University. Whipple raises the question as to whether roentgenology will continue to be a specialty or whether it will be taken over by the general practitioner and the other specialists, but he does not risk an answer or a prophecy.

The individual chapters form an interesting study in comparing methods of presentation, of writing, of illustration and even of the attitude of the author or authors. *Chapter 1*, by C. G. Dyke, of the Neurological Institute, concerning the skull and brain, for example, is very condensed, almost staccato in its sentences and rather incomplete. It reads as if it were a dictionary of skull and intracranial disease rather than an inclusive treatise. The illustrations are excellently chosen, all in natural (i.e. negative) reproduction, rather than the positives which are so apt to confuse the student or the beginner. Most of the illustrations, however, in this chapter are too small to be really valuable. Some of them could well be enlarged, others could well have been made from an enlarged section of the roentgenogram. It is interesting to note that "acromegaly" has much more space in the chapter on bones than it does

in Dyke's chapter where it belongs. On the whole, it is one of the best presentations in English of the roentgen aspects of the skull and the intracranial contents but yet it leaves much to be desired to approach perfection. This chapter should be doubled or trebled in size and content, as it is one of the most confusing and least understood branches of our specialty. Clinical and pathological material should be included and coordinated to round out the presentation, as has been done in Chapter 6.

Chapter 2, by G. W. Grier, of Pittsburgh, concerns the sinuses and mastoids. He gives but little on technique, emphasizing only the stereoscopic examinations which he classes as most important. His terminology is simple, his descriptions clear and concise and his classification of disease is factual rather than arbitrary or theoretical. The section on tumors, however, is weak and most of the rare and unusual diseases and conditions are omitted. All illustrations are positives and are well reproduced. There are only two photographs or drawings concerning technique.

Coleman B. Rabin, of New York, has written an excellent section on radiology of the chest in *Chapter 3*, which covers 135 pages. Rabin was a good choice as he is an Associate in Medicine for Chest Diseases, a Radiologist, and holds a post in Morbid Anatomy—a rare combination and one which gives a broad vision which is reflected in his chapter. His material is well organized, his descriptions are clear and his differentiation worthy of commendation. All of his illustrations are positives, nearly all of them good, and large enough to be carefully studied —a difficult feat in reproduction. The bibliography is fairly good, but lacks the proper separation or set-out for the individual headings, a fault common to all chapters using separate subtitles for bibliography in this book. One interesting statement (that the rising of the aorta with swallowing is a most important fluoroscopic finding in adhesive pericarditis, p. 186) is not even mentioned in the succeeding chapter on heart disease. The section on pulmonary abscess is particularly well done, that on silicosis rather slighted.

Chapter 4, concerning the cardiovascular system, was written by Hugo Roesler, of Philadelphia, and is probably the most scholarly contribution in the book. It covers 67 pages and, although obviously condensed, is one of the most nearly complete chapters. Cardiac conditions are presented in a new manner, not only from a clinical as well as a roentgenological viewpoint, but also from the static, dynamic and etiological aspects. The illustrations are nearly all negatives (i.e. natural) but are liberally sprinkled with heavy arrows to the point of detraction. There are excellent short summaries of the case with most of the illustrations, in addition to a description of characterization of the case as an example. Golden uses the same method in his illustrations and the other authors might well have copied this style—as it ties up the patient as well as the disease with the roentgenogram. Cardiac anatomy and pathology are very well covered. The bibliography for this chapter is in a single list and is quite well selected and complete.

Golden has written an excellent treatise on the gastrointestinal tract and the gallbladder in *Chapter 5*, which covers 85 pages with 73 illustrations, combining the clinical and frequently the pathological findings both in text and in illustrations. The context is complete, concise and authoritative. Again the rare and unusual have been slighted of necessity by space limitations. More line drawings and some spot films to show mucosal detail and abnormalities could well be added. The bibliography is again in a single list and is fairly complete.

Chapter 6, concerning the bones and joints, is probably the best one in the book—the most complete, most descriptive, and easiest to read. It was written by Hodges, Phemister and Brunschwig of Chicago, a happy combination of clinicians and roentgenologist in this particular case. This chapter is the longest in the book (210 pages) and there seems to be a freedom from condensation and lack of worry about space. Some of the illustrations in this chapter are poorly chosen, however, even to the point of being absolutely useless. Most of the illustrations, however, are clear and well chosen, positives in the first half, negatives in the sections on metabolic diseases, arthritis, etc., evidently written or at least illustrated by a different one of the trio of authors. Uniformity of illustrations is desirable, especially for beginners and students who are often confused by positive reproductions, and this section is especially commendable. The illustrations shift to positive again in the final section on tumors of bone, and on the whole are not as well chosen as in the middle section. Roentgenograms of surgical or pathological specimens are very suitable in a chapter on this subject and could have been used to advantage in quite a few

more places in addition to the ones selected. The descriptions and illustrations of Legg-Perthes' disease, xanthomatosis and Paget's disease are excellent and deserve special praise, presenting as they do not only the roentgenographic appearances but also the etiology, the pathology, the clinical features and even the treatment of these diseases—an ideal textbook arrangement for roentgenologists who are too prone to content themselves with a differential diagnosis. On the whole, Chapters 4, 5 and 6 are worth the price of the whole book.

Chapter 7 on spinal cord tumors is by Dyke and also suffers from too much condensation and too much emphasis on interpedicular measurements. It is quite incomplete, especially on diagnosis and study following lipiodol injection. It covers 21 pages.

Jaches and Sussman, of New York, have written *Chapter 8* on the urinary tract, covering 131 pages with 154 illustrations. The section on "Methods of Investigation" is particularly good and the presentation of intravenous urography especially noteworthy. The whole chapter is well organized, well arranged and well presented except for the almost complete absence of line drawings and diagrams and of gross pathological material which could add considerably to clarity and precision.

Chapters 9, 10, and 11 are more or less in the nature of addenda. *Chapter 9* by Robins and Shapira, of Boston, concerns uterotubography. It is a comprehensive article, well illustrated, all in negative prints, and devotes 39 pages to a method which is used in only a few clinics. The bibliography is very good.

Chapter 10, on obstetrics, by Moloy and Swenson, of New York, is fairly complete, covering 71 pages, but the major portion is devoted to pelvimetry and anatomical variations of the human pelvis, to the detriment of discussion and details of more clinically useful information. More emphasis should have been put upon the abnormal fetus, abnormal positions, multiple pregnancies, extrauterine complications, etc.

The final *Chapter 11*, by Skinner, of Kansas City, covers fractures in 26 pages without adding much to the book as an encyclopedia but completing it as a textbook. The short section on medicolegal aspects could well have been expanded, as this is an ever-increasing problem which faces nearly all roentgenologists as well as surgeons, orthopedists and general practitioners who treat fracture cases.

The index covers 13 pages of standard type and is fairly complete but not detailed, with few cross references. Subjects are apt to be under nonspecific headings such as "Disease" or "Kidneys" rather than nosographic or eponymic listing. To this reviewer an index is like the temperature chart, it gives at a glance a fair estimate of the condition of the patient. This index is good but incomplete, well printed, accurate as far as it goes and covers the major portion of roentgenological diagnosis particularly the more common things very well indeed. And so does the book! It is well worth the price and the editor and collaborators deserve our hearty thanks for undertaking and completing such a herculean and such a thankless task for the benefit of Roentgenology. But not yet can we cry "Excelsior."

CLINICAL ROENTGENOLOGY OF THE CARDIOVASCULAR SYSTEM: ANATOMY, PHYSIOLOGY, PATHOLOGY, EXPERIMENTS AND CLINICAL APPLICATIONS. By Hugo Roesler, M.D., Associate Professor of Roentgenology and Cardiologist, Department of Medicine, Temple University School of Medicine, Cardiologist, Temple University Hospital, Consulting Cardiologist, Shriner's Hospital for Crippled Children, Philadelphia, Pennsylvania. Cloth. Price, $7.50. Pp. 343, with 199 illustrations. Springfield, Illinois: Charles C. Thomas, 1937.

At last an authoritative book has been written on the clinical roentgenology of the cardiovascular system. If fills a need that has been long felt by internists, cardiologists and roentgenologists.

The clinical evaluation of the roentgenologic method is so clearly stated in the preface that it should be quoted.

> The examination of the cardiovascular system by means of the roentgen rays is but one among several methods of study . . . the application of one method sets very definite limitations to the desire to know and to understand the "whole." Certain aberrations from the normal in the cardiovascular system can be demonstrated by roentgen studies only; a certain number are better diagnosed by roentgenologic than by clinical methods, while very many early changes can be elicited only by clinical methods. Often negative roentgen findings are as valuable as positive ones. To disregard this method means to renounce much of what our best trained sense, the eye, can perceive. . . . Its worth as well as its limitations must be evaluated by basic knowledge of the normal and pathological anatomy and physiology of the

cardiovascular system on the one side, and of the fundamental, theoretical and applied principles of the roentgen rays on the other. Deficient training and deficient insight into problems will only lead to disappointment and to misinterpretation of results. It is inherent in any method that he who uses it tries to do as much as possible with it, and tends to overestimate its worth the more he knows of it or is limited to its use; and that he who cannot use a method tends to neglect and to underestimate it.

The book begins with a practical discussion of the technique and apparatus employed in roentgenoscopy, orthodiagraphy, roentgenology, cinematography, kymography and vasography. Perhaps too much stress is placed on orthodiagraphy since the method is used so little in this country.

The chapters on the roentgenologic anatomy of the intrathoracic cardiovascular system are complete and emphasize the topographical relationships of the cardiac chambers and great vessels. Of special value are the detailed anatomical studies of the lateral, right anterior oblique, and left anterior oblique positions. The accompanying illustrations are excellent and should be copied to serve as reference charts in the roentgen laboratory.

Alterations in the size and outline of the heart and great vessels are presented from the viewpoints of etiology and structural changes. The effects of the various diseases and metabolic disturbances are ably discussed, and these chapters will serve as a textbook on the subject.

The roentgenologic aspects of the normal and diseased aorta and pulmonary arteries are clearly and thoroughly presented, including the diagnostic considerations of aneurysms. Ample space is given to pericardial effusion and to diseases of the pericardium. The chapters on congenital cardiovascular malformations and disorders of cardiac rhythm are complete and splendidly organized for clinical use. The closing chapter is a brief summary of vasography.

The subject matter is enhanced by the liberal use of instructive statistics. The reproductions are unusually clear, as might be anticipated in work from the laboratory of Dr. W. Edward Chamberlain. A complete and largely foreign bibliography supplements each chapter. This book brings attention to the fact that the roentgenologic examination is not limited to a statement of the size and outline of the heart, but includes an analysis of the physiologic and dynamic activities of the heart and vascular tree. The author has succeeded in making the book a rich mine of practical and clinical information of the anatomy, physiology, pathology and roentgenology of the cardiovascular system. It is unhesitatingly recommended to all students and physicians interested in the examination of the heart and vascular tree.

Wendell G. Scott

The Digestive Tract: A Radiological Study of its Anatomy, Physiology, and Pathology. By Alfred E. Barclay, O.B.E., M.A., M.D. (Cantab.), D.M.R. & E. (Camb.), M.R.C.P., F.A.C.R., Honorary Radiologist to the Nuffield Institute for Medical Research, Oxford; Formerly Lecturer in Medical Radiology, University of Cambridge, Hon. Medical Officer in charge of the X-ray Department, Manchester Royal Infirmary, and Lecturer in Clinical Radiology, University of Manchester, etc. Second edition. Cloth. Price, $12.00. Pp. 427, with 296 illustrations. Cambridge: At the University Press; New York: The Macmillan Company, 1937.

Completely revised and reset, with many additions and changes to keep abreast of roentgenologic progress, the second edition of Barclay's book has come from the other side of the Atlantic. Although of all peoples the British are supposed to be the most firmly bound by tradition, Barclay has refused to accept its authority with respect to the facts of roentgenology. Accordingly, his book reflects a refreshingly original viewpoint derived from his own observations. This is especially true of his presentation of the anatomy and physiology of the digestive tract, to which the first half of the volume is devoted. For example, he presents evidence for his conclusion that the act of deglutition is produced by negative pressure in the pharynx. His study of the function and behavior of the cardiac orifice is likewise interestingly original. It is not to be implied that Barclay ignores the experience and well-founded opinions of others, for he cites freely from an extensive bibliography in which American roentgenologists are generously represented. His descriptions of the roentgenologic manifestations of gastrointestinal lesions are also based largely on his own observations but are often supplemented by the opinions and experience of other observers. In the main, he deals with the essential facts briefly, and "padding" is conspicuous by its absence. It is note-

worthy that he has become convinced that there is no such thing as gastroptosis in the generally accepted sense. In a final chapter he gives details of his painstaking investigations into roentgen hazards and concludes that in any well-ordered radiological department, and with the usual precautions, the risk to operator and staff is slight.

This second edition, like the first, will be well received by American roentgenologists, not merely because Dr. Barclay has frequently visited this country and has made a host of warm friends here, but because he is an outstanding pioneer and leader in roentgenology, and all that he writes is entitled to respectful consideration.

B. R. Kirklin

Handbook of Orthopaedic Surgery. By Alfred Rives Shands, Jr., B.A., M.D., Associate Professor of Surgery in charge of Orthopaedic Surgery, Duke University School of Medicine, and Chief of the Orthopaedic Service, Duke Hospital, Durham, North Carolina, etc. In Collaboration with Richard Beverly Raney, B.A., M.D., Instructor in Orthopaedic Surgery, Duke University School of Medicine. Cloth. Price, $5.00. Pp. 593, with 169 illustrations. St. Louis: The C. V. Mosby Company, 1937.

The author states in his preface to this volume that an attempt was made to present, not the views of one man or of one school, but the consensus as recorded in the orthopedic textbooks and in the more recent orthopedic literature, criticized and tempered with the experience and thought of twenty-four teachers of orthopedic surgery and allied subjects representing eighteen different medical schools. Each chapter was reviewed by more than one authority. When there were conflicting opinions, the authors reserved the right to choose the subject matter which they thought most suitable. Because of limitation of space, certain important parts of orthopedic teaching were omitted; among these were the subjects of fresh fractures, plaster technique and orthopedic apparatus, as well as certain forms of treatment which in the past have been widely used but which are not generally accepted today.

The subject matter of the text is divided into twenty-four chapters in accordance with a report of the Committee on Undergraduate Instruction in Orthopaedic Surgery of the American Orthopaedic Association. Sixteen of the chapters are based upon pathology; seven chapters are arranged according to anatomical region, and include disease entities which do not readily fall into the pathological grouping.

The book is well printed, its size is not bulky and is well adapted for ease in reading. The text is concise but not too brief to neglect essential description of the various diseases. Illustrations which were taken from textbooks and journals were all redrawn. The majority of the illustrations are original pen and ink drawings, many of which were made from specimens provided by the authors' collections of pathologic bones. No photographs or roentgenograms were reproduced directly; all were redrawn to emphasize their characteristic features. With regard to roentgenograms, the wisdom of this may be questioned, since much is lost by lack of reproduction of roentgenograms which show clear bone detail. The bibliography is complete and for the student of orthopedic surgery is a most useful adjunct.

The revision of its contents by numerous competent authorities, the concise but still sufficiently descriptive text, the bibliography and the logical arrangement of its subject matter, tend to make this a valuable addition to the textbooks on orthopedic surgery.

Ralph S. Bromer

La spondylolyse et ses conséquences: spondylolisthésis; scoliose listhésique. Par Pierre Glorieux, Bruges, et Carle Roederer, Paris. Paper. Price, 60 fr. Pp. 208, with 138 illustrations. Paris: Masson & Cie, 1937.

The authors of this monograph define "spondylolyse" as a solution of the continuity of the posterior vertebral arc at the narrow portion which they designate as the interarticular isthmus, situated between the superior and inferior articular apophyses. This defect may be a congenital anomaly or a pathological lesion. It may be unilateral or bilateral, single or multiple. It may be found in any part of the vertebral column, but it most often occurs in the lower lumbar region.

The book is divided into two parts. The first covers the pathological anatomy of spondylolysis, both macroscopic and microscopic, with a discussion of the three etiologic theories, the congenital, the traumatic and the static. The

last chapter of this part deals with the symptomatology and clinical picture which occasionally is obscure until actual displacement of the affected vertebra occurs.

The second part of the book is devoted to the complications which arise from this defect in the neural arch. The first complication is spondylolisthesis. The pathological anatomy, the clinical picture and differential diagnosis are described in detail. Prespondylolisthesis, the tilted sacrum, pseudolisthesis and retrospondylolisthesis are in turn considered.

The second complication which may occur is scoliosis. The mechanism of its production, its symptomaology and treatment are covered in another chapter. The treatment of the defect when discovered, either with or without occurence of spondylolisthesis, forms still another chapter. The etiologic factor, whether congenital, traumatic, static or mechanical, determines the choice of method of treatment. Various operative procedures are described in full.

The roentgenographic technique recommended is a target-film distance of 150 cm. with Potter-Bucky diaphragm exposures. A cone is used which permits a field 18×40 cm. for lateral views in thin patients and a cone with a field 15 cm. in diameter in heavy patients. Stereoscopic anteroposterior and single lateral views are recommended with the patient supine. Single anteroposterior, lateral, right and left oblique exposures are made with the patient sitting. The normal roentgenographic appearance of the lumbar vertebrae, especially the fifth, is fully described.

Since the authors admit a traumatic factor in the production of spondylolisthesis, a short chapter is devoted to the medicolegal aspects of the condition. The bibliography is complete. The book contains numerous exceptionally clear and graphic reproductions of roentgenograms which are supplemented in many instances by line drawings to clarify further the roentgen findings.

This monograph is a valuable addition to the roentgenologist's library, because of the thorough and detailed presentation, the numerous excellent roentgenograms and the complete discussion of a condition to which very little space is usually given in textbooks of roentgenology.

Ralph S. Bromer

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DEPARTMENT OF TECHNIQUE

Department Editor: Robert B. Taft, M.D., M.S., 105 Rutledge Ave., Charleston, S. C.

HALF STRENGTH THORAEUS FILTER DEPTH DOSE DETERMINATIONS ON PATIENTS

By HILLYER RUDISILL, JR., M.D., F.A.C.P.
CHARLESTON, SOUTH CAROLINA

WE HAVE thought it of interest to present these figures for two reasons: (1) We have not seen in print any depth dose figures for the very useful half strength Thoraeus filter. (2) Practically all published depth dose figures, with any filter, have been obtained on phantoms of water, paraffin, etc., and the phantom depth dose is never accurately applicable to the human body. There are at least three greatly varying densities of human tissue (which have been recognized in diagnostic roentgenology for years) in which totally different depth doses are obtained: namely, skull, thorax and muscle—bone combinations which include the abdomen and pelvis.

It is hoped that this rather sketchy series will encourage others to make and to publish more extensive depth dose determinations on patients, with various filters, voltages, distances, and other variable factors.

All of the determinations in Table 1 were made with the following constant factors. A new Victoreen condenser (removable ionization chamber type) r-meter, that checked exactly with the r-meter used by the physicist of one of the large roentgen manufacturing companies, registered all of the measurements.

Generator—half wave valve rectified.
200 kv. (peak) as measured on standard sphere gap.

Table I

Field in cm.	Part of the Body	Surface Dose	Depth Doses at Various Levels				
			5 cm.	7.5 cm.	10 cm.	15 cm.	20 cm.
5×5	(1) Lower third of the thigh	25 r	—	—	4.25 r	—	—
5×5	(2) Right chest at nipple (male)	25 r	—	—	—	—	4.00 r
5×5	(3) Female pelvis	25 r	—	—	—	1.50 r	—
5×5	(4) Female pelvis in vagina	25 r	—	6.75 r	—	—	—
5×5	(5) Mouth inside left alveolar margin	25 r	15.00 r	—	—	—	—
5×5	(6) Left chest at nipple (child)	25 r	—	—	7.00 r	—	—
5×5	(7) Skull—young adult	26.50 r	—	—	2.00 r	0.75 r	—
10×10	Same as (1)	26.50 r	—	—	7.25 r	—	—
10×10	Same as (2)	26.50 r	—	—	—	—	6.00 r
10×10	Same as (3)	26.50 r	—	—	—	2.25 r	—
10×10	Same as (4)	26.50 r	—	8.00 r	—	—	—
10×10	Same as (5)	26.50 r	18.00 r	—	—	—	—
10×10	Same as (6)	26.50 r	—	—	13.00 r	—	—
10×10	Same as (7)	28.00 r	—	—	4.00 r	1.25 r	—
15×15	Same as (2)	29.00 r	—	—	—	—	12.00 r
15×15	Same as (3)	30.00 r	—	—	—	4.00 r	—
15×15	Same as (4)	30.00 r	—	11.25 r	—	—	—
15×15	Same as (6)	28.00 r	—	—	18.00 r	—	—

Each figure represents the average of at least four separate readings.

15 ma. checked with tandem meters.
50 cm. focal skin distance.
Filter—half strength Thoraeus, that is $\frac{1}{8}$ Sn, $\frac{1}{4}$ Cu and $\frac{1}{4}$ Al.
Half-value layer—1 mm. Cu.
Tube—circulating oil cooled and insulated.

An erythema is produced with the above factors and a 10×10 cm. field when 300 r per day, at the rate of 25 r per minute measured in air, is given on six consecutive days, making a total dose of 1,800 r.

SUMMARY

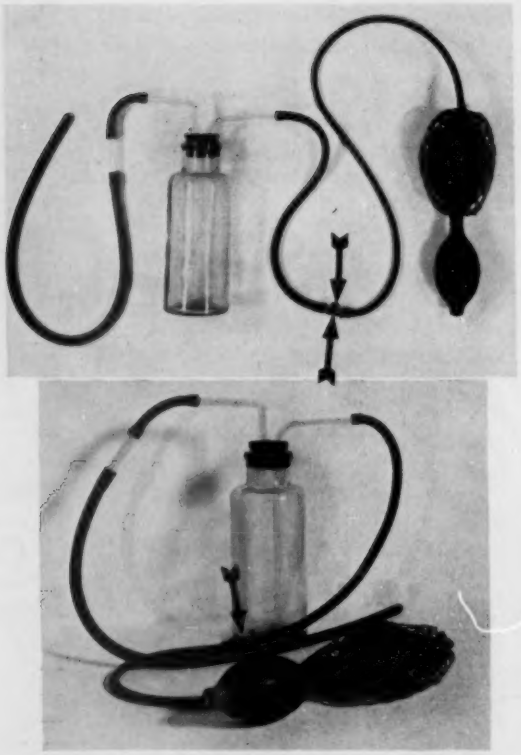
A few depth dose determinations are given in table form and it is interesting to note that with constant factors, including a constant 10×10 cm. field, the depth dose compared to the surface dose varies from 13 to 43 per cent, depending on the part of the body irradiated.

CONCLUSIONS

Phantom depth dose measurements should be replaced as soon as possible with human depth dose figures which will take into consideration the densities of the portions of the body treated.

A SIMPLE INEXPENSIVE APPARATUS FOR INJECTION OF AIR IN DOUBLE CONTRAST ENEMAS*

By WILLIAM S. ALTMAN, M.D.
Beth Israel Hospital
BOSTON, MASSACHUSETTS



THE apparatus devised and used by us for injection of air in double contrast enemas consists of the following (see illustration).

1. A cautery bulb.
2. An Air-Flo control valve (note arrows).
3. A bottle with a two-hole stopper.
4. Glass tubing for connections.
5. Connecting rubber tubing.
6. A rectal tube.

This outfit can be made very inexpensively and allows a slow, controlled, unidirectional passage of air into the colon, with practically no discomfort to the patient. The bottle acts as a trap and prevents reflux flow of barium from plugging the valve. Loosening the valve allows escape of air from the colon, when so desired.

* From the Radiological Department of Dr. Samuel A. Robins.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

Bernard, P., and Trotot, R. Sur un cas de maladie de Crouzon. Présentation de radiographies du crâne. (A case of Crouzon's disease; presentation of roentgenograms of the skull.) *Bull. et mém. Soc. de radiol. méd. de France*, Feb., 1936, *24*, 132-133.

The authors had the opportunity to observe a case of Crouzon's disease in a new-born in which roentgenograms were made the day after birth. The examination revealed the following outstanding findings: (1) Skull: A prominence at the upper part of the frontal with enlargement of the two temporoparietal regions giving the skull, when looking from above, a distinct trilobulated appearance. There was absence of the fontanelles except at the superior aspect of the anterior prominence where there was a slight and thin anteroposterior distortion. (2) Face: Parrot-beak-shaped nose with some enlargement of the root of the nose. The child was breathing very poorly, nearly always through the mouth, and there was some cyanosis of the face. Furthermore there was prognathism of the mandible and thickening of the lower lip, the inferior gingival border being in front of the superior lip which in turn was very small. Finally, there was atrophy of the maxilla and a complete absence of the union of the two maxillae at the level of the hard palate. (3) Eyes: There was bilateral exophthalmos, more pronounced on the left side where there was complete enucleation of the eye. The right eye showed slight external strabismus but this probably was secondary to the fact that there was no concomitant movement of the left eye. The fundus examination revealed atrophy of the optic nerve with the presence of filiform arteries and subnormal veins.

Three weeks later a removal of the left eye was attempted but the child died during the intervention as the result of chloroform syncope. The autopsy completely confirmed the findings of the roentgen examination. An important feature was the very marked condensation of the bones at the base of the skull, sellar region and at the level of the labyrinths of the petrous bone. This osseous dystrophy seems to bring a new contribution to the already important iconography of condensing osteitis.—*T. Leucutia.*

Casati, Annibale. Sopra un caso di iperostosi frontale interna. (A case of internal frontal hyperostosis). *Radiol. med.*, Aug., 1936, *23*, 625–632.

The author describes a case of internal hyperostosis of the frontal bone in a woman of fifty. The patient had always had a tendency to obesity, especially in recent years. She began to menstruate at nine years of age and after a normal menstruation for some years became irregular amenorrheic. At nineteen she married a normal man and had two pregnancies ending in abortion. In 1922 she suffered a slight scalp wound over the right parietal bone. In 1930 she suffered paralysis of the right facial nerve and in 1932 neuralgic pain began in the right frontal and parietal region.

Roentgen examination showed the skull normal in size and form; there was a thickening of the internal table of the frontal bone reaching back to the coronary suture; it was irregular in outline and homogeneous in appearance. The external table was normal. There were no signs of decalcification, erosion or sclerosis.

This is a characteristic form of hyperostosis of the internal table only of the frontal bone which occurs usually in women in the fifth decade of life. It seems to be due to disturbed metabolism of fats and calcium brought about by hypofunction of the ovary.—*Audrey G. Morgan.*

Samuel, E. C., and Bowie, E. R. Roentgenographic study of the sphenoid sinus. *New Orleans M. & S. J.*, April, 1936, *88*, 632–634.

The value of the Hirtz, chin-vertex, vertex mental or mento-vertex position as a supplemental measure to the Granger technique for roentgenography of the sphenoid sinus is discussed. This position gives important information as to the presence or absence of sinus pathology by gradations of density and character of the upper limit of the sphenoidal area. It does not furnish information relative to the septum, the lateral extent of the sinus, the ex-

tent of division within the sinus or of the presence of partial septa. The authors prefer the chin-vertex position, either supporting the shoulders by a pillow and bending the head backwards, or by bringing the shoulders to the edge of the table and allowing the head to hang over the edge, the vertex resting on the cassette supported on a low table. The image of the lower jaw must be thrown as far away from the sphenoid as possible.—*W. R. Brooksher.*

LEBOURG, L. L'ostéo-thorio-nécrose tardive des maxillaires. (Late osteo-thorio-necrosis of the maxillae.) *Presse méd.*, March 11, 1936, *44*, 417.

The occurrence of extensive necrosis of the maxillae following prolonged treatment with thorium X is now conclusively established. The literature includes 5 definite cases in this respect.

The necrosis, which is of extremely slow evolution, may develop in two ways: in a first group, after common tooth extraction which is performed without the slightest difficulty, the gum fails to cicatrize, then secondary infection sets in although the suppuration is always rather slight, and finally after several weeks the mucosal gingiva is absorbed and the bone of the alveolar process becomes denuded. In a second group, the necrosis occurs spontaneously in a portion of the alveolar process which has been edentulous for a long time. Without apparent cause a painless tumefaction of the gum appears, and after several weeks a resorption of the gingiva and a denudation of the bone follows. From this moment on the two forms run an identical course. The necrosis of the alveolar process of the jaw continues at a slow pace but without any possibility of spontaneous reparation. In the superior maxillae the process is a little more rapid than in the mandible and associated with little pain. The most interesting part, however, is in connection with the phenomena of the sinuses. A collection of pus, then definite empyema and finally a bucco-sinusal communication with permanent fistula represent the various stages of these phenomena. In the mandible, the necrosis evolves more slowly and is always associated with continuous neuralgias or paroxysms of extreme violence. In the beginning the general condition of the patient is unaffected, but later a fatal buccal cachexia develops.

The patients observed received an average of five series of 8 injections of increasing doses of from 50 to 150 micrograms of thorium X. From this it appears that the osseous fragility occurs with about 5,250 micrograms, and therefore it is the author's opinion that the administration of thorium X in fractionated doses should never exceed the total amount of 4,200 micrograms. As concerns the treatment of radionecrosis, this is purely symptomatic.—*T. Leucutia.*

PETIT-DUTALLIS, D., and ECTORS, L. A propos de certaines formes anormales des méningiomes: tumeurs multiples, tumeurs récidivantes, tumeurs infiltrantes. (Concerning certain abnormal forms of meningiomas: multiple tumors, recurring tumors, infiltrating tumors.) *Presse méd.*, March 21, 1936, *44*, 486–490.

The meningiomas, well known since the celebrated monograph of Cushing, usually represent solitary tumors. Originating at the expense of the arachnoid, they appear limited by a capsule of their own which separates them from the brain which they displace without invading. Thus they behave more like a benign tumor without tendency to recurrence, once completely removed.

There are, however, exceptions to the rule. The present article deals with such exceptions, stressing chiefly the possibility of the multiplicity of some meningiomas, the tendency to recurrence, and the invasive nature of others. In connection with the first, cases are cited from the literature in which as many as 25 and in one case even 100 meningiomas were observed simultaneously. In connection with the second and third, 2 cases which were observed personally by the authors are described in lengthy detail.

The following conclusions are reached: The meningiomas do not always represent single, encapsulated tumors permitting a complete healing after local removal. One may observe multiple tumors in which instance a coexistence with other neoplasms (especially neurinomas of the acusticus) may occur. This multiplicity explains in large measure the possibility of recurrence, if not all of the tumors were removed at the time of the operation. Finally, in exceptional cases the meningioma may perforate its limiting capsule and invade directly the brain, in which instance the tumor assumes a locally malignant character, making a complete removal practically impossible.—*T. Leucutia.*

NECK AND CHEST

Debré, Robert. La dilatation des bronches; malformation congénitale. (Dilatation of the bronchi; congenital malformation.) *Presse méd.*, March 4, 1936, *44*, 353–355.

The conception that in many instances dilatation of the bronchi, or common bronchiectasis, is of congenital origin seems lately to occupy an increasingly prominent part in the medical literature. After studying 20 cases with a complete follow-up for a period of over fifteen years, the author arrived at the following conclusions: (1) Bronchiectasis in childhood is usually associated with a congenital malformation. (2) It does not usually lead to death and there is no doubt that a number of bronchiectases in adults is the consequence of bronchiectasis in childhood. (3) All intermediary forms exist from the very slight congenital bronchiectasis, which is usually latent and discovered only at autopsy, to the bronchiectasis of Letulle, infected or non-infected common bronchiectasis, pulmonary aerocysts which are still compatible with life, and finally to the cystic disease of the lungs which leads to death of the fetus in utero. (4) Apart from the congenital origin bronchiectasis may occur also as the result of tuberculosis, syphilis, cancer, foreign bodies, gangrene, and suppuration of the lungs, but in all these instances it is assumed that the bronchiectasis is of a secondary nature. The occurrence of this form in childhood is exceedingly rare. (5) It is not conclusively demonstrated that a severe bronchopneumonia may result in bronchiectasis. (6) Even in the cases in which bronchiectasis coincides with cancer or abscess the question arises as to whether or not the malignant process or the inflammation is not superimposed on a malformation of congenital origin. (7) It is even possible, though this remains to be proved, that bronchopneumonia which seems to be the cause of bronchiectasis may in reality represent nothing more than an infectious episode in a case of latent bronchiectasis.

To sustain all of these conclusions the author makes a very detailed review of the literature by discussing in extenso especially those cases which, in the minds of various investigators, represented instances of proved or at least suspected congenital lesions. In this respect, the article contains considerable argumentative material and it finishes with the following statement by the author: One does not intend to deny the existence of acquired bronchiectases, especially those secondary to an abscess, any more than one would deny the existence of acquired hydronephrosis in favor of a congenital hydronephrosis; yet it appears that the position of the etiologic problem is at the present time reversed. It is from now on up to those who believe in the acquired origin to furnish proof in the individual cases that some well-defined morbid episode is at the basis of the bronchial dilatation, otherwise the congenital origin may be assumed.—*T. Leucutia.*

Battigelli, G. A. Polmone policistico congenito puro. (Pure congenital polycystic lung.) *Radiol. med.*, Aug., 1936, *23*, 620–625.

A case is described in a patient twenty-nine years old. She was the 14th of her mother's 18 children and was very much retarded in development. In 1930 she suffered with cough, catarrh and fever and was sent to a hospital where a right upper pneumothorax was advised, which she refused. She recovered and was dismissed. In 1931 she had a similar attack and was in a hospital for four months but improved. When she came to the author for examination she did not present clinical or roentgen signs of tuberculosis. But the roentgenogram of the right upper lobe showed round or polyhedral areas of exaggerated clearness of varying sizes bounded by delicate septa, which gave the lung a spongy, trabeculated appearance. Bronchography showed a series of small sacs in this lobe attached to the terminal branches of the bronchi. These had completely replaced the normal structure of the lung.

This was a case of pure congenital polycystic lung; that is, it was not associated with inflammatory or reactive processes. The essential feature of this disease is congenital dilatation of the alveoli. The roentgen picture, particularly the bronchographic picture, is characteristic.—*Audrey G. Morgan.*

Filla, Enrico. Caso singolare di coesistenza di un vasto pneumotorace extrapleurico e di un pneumotorace intrapleurico. (Singular case of coexistence of a vast extrapleural pneumothorax and an intrapleural pneumothorax.) *Radiol. med.*, 1936, *23*, 439–444.

A case is described in a girl twelve years of age, who had been under pneumothorax treatment for about a year when on one insufflation the air was introduced, not into the pleural cavity but outside the pleura between the

pleura and chest wall. The subpleural sac was so large that for some months refillings were made into it without the mistake being discovered by the attending physician. The thickened parietal pleura had evidently become detached from the wall and the insufflation made into the extrapleural space. This error did not cause any symptoms except that the child felt hypochondriac pain after each filling. When the error was discovered and intrapleural insufflations made there was a rapid subjective and objective improvement in the child's condition.—*Audrey G. Morgan.*

Clerc, Delherm, Fischgold, and Frain. Trois cas de corps étrangers intra-cardiaques. (Three cases of intracardiac foreign bodies.) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1936, *24*, 183–185.

Three cases of intracardiac metallic foreign bodies were observed by the authors, 2 following wounds received in the war twenty years ago, and the third following a recent hunting accident. In none of the cases was there any evidence of functional disturbance and the clinical as well as the electrocardiographic examinations remained normal. From the point of view of roentgen examination several questions arose: (1) Was the foreign body an intra- or an extracardiac one? To answer this question it was necessary to examine the patient roentgenoscopically in all possible incidences so as to observe whether or not the foreign body could be visualized at any time outside of the cardiac shadow. (2) If the foreign body is an intracardiac one, the further questions arise: (*a*) whether it is within the ventricular cavity. If such be the case the foreign body appears greatly mobile showing a spinning motion due to mixing of the blood during the filling of the cardiac cavity; (*b*) whether it is within the walls of the heart. All 3 cases observed by the authors belong in this group and a review of the literature shows that this localization represents practically the site of all of the cases reported. If the foreign body is within the cardiac wall a displacement is observed which follows the contraction of the muscle and which is extremely well demonstrated in kymography; (*c*) whether the foreign body is within the pericardium. Here the differentiation may be exceedingly difficult, the movements of the foreign body being identical to those observed when they are within the walls of the heart. Here, too, kymography may be of great aid.

The 3 cases are briefly described. The conclusion is reached that all cases of intracardiac foreign body show with preference an intraventricular localization. It is probable that an injury of the very thin wall of the auricle by a foreign body always results fatally.—*T. Leucutia.*

Perona, Pietro. Contributo allo studio della trombosi cardiaca. (Study of cardiac thrombosis.) *Radiol. med.*, 1936, *23*, 403–417.

The author gives kymograms illustrating the findings in chronic thrombosis of the myocardium. In chronic coronary thrombosis, the lower half of the margin of the left ventricle shows a marked limitation of its movements, presenting generally a finely sinuous outline of the profile of the ventricle in which the points of the movements can hardly be distinguished. This picture is brought about by the fibroplastic reaction of the myocardium and possibly also by disturbances of conduction and reception of stimuli. Other details of the picture are shown in the kymograms.

He also describes a case of aneurysm of the wall of the left ventricle brought about by small foci of infective myocarditis which so weakened the wall that it yielded and formed an aneurysm. The kymogram showed pulsations of a distinctly ventricular type with more marked excursions than in any other part of the heart, their outline suggesting the presence of the aneurysm. An electrocardiogram in this case did not show anything abnormal. Nevertheless the kymogram should be used to supplement not to replace electrocardiographic findings.—*Audrey G. Morgan.*

Torelli, Gastone. Limiti ed errori della roentgenchimografia polmonare. (Limits and errors of pulmonary roentgen kymography.) *Radiol. med.*, June, 1936, *23*, 432–438.

The author gives a detailed and technical description of roentgen kymography of the lungs and discusses the possible technical errors of this procedure. These errors are not very great, however, and if they are taken into account in interpreting the kymogram they do not greatly limit the value of the method, particularly in studying the movements of the diaphragm and mediastinum, which cannot be registered graphically by any other method. The author believes that the technique with a fixed grid gives better results than that with a movable grid and fixed film. —*Audrey G. Morgan.*

ABDOMEN

Rhinehart, D. A. Concerning stomachs that are upside down. *South. M. J.*, Feb., 1936, *29*, 139–142.

The rare abnormal position of the stomach, inversion, is discussed. Associated and causal factors are: congenital absence, congenital and acquired hernial openings of large size, eventration, and paralysis of the diaphragm. A case of inverted stomach in which there was an intact and normal diaphragm is presented.—*W. R. Brooksher.*

Schmerchinich, Giovanni. Gastrite pseudopoliposa a focolaio unico. (Solitary focus of pseudopolypous gastritis.) *Radiol. med.*, July, 1936, *23*, 552–554.

Pseudopolypous gastritis appears on the roentgenogram of the mucous membrane relief in the form of a protruding clear space with well-defined curved borders. The surrounding folds may be enlarged or normal. The author describes 3 cases that he has seen and gives illustrative roentgenograms. In all 3 of the cases the clinical picture was that of gastritis. In all 3 roentgenograms there was a rounded protrusion of the mucous membrane enclosed in a ring of barium with well-defined outlines. The outlines were clearer than for cancer and a circular ulcer would probably not have reached such a size without serious hemorrhage. To differentiate between polyp and gastritis repeated examinations must be made; in the course of time, the picture of gastritis will be found to be quite different from that of polyp, unless the focus of gastritis develops into a true adenomatous or fibrous polyp.—*Audrey G. Morgan.*

Chierici, Romolo. Ulcere doppie e multiple del duodeno. (Double and multiple ulcers of the duodenum.) *Radiol. med.*, Sept., 1936, *23*, 657–672.

Among 235 autopsies in stomach cases at the Littorio Hospital the author found double or multiple ulcer of the duodenum in 58 cases, or almost 25 per cent. While it is quite possible with good technique to make a roentgen diagnosis of ulcer of the duodenum, it is frequently quite impossible to show that the ulcer is double or multiple. The author compares the roentgen and autopsy findings in these cases, illustrating them with roentgenograms. In 38 of the cases there were two ulcers, one on the anterior and one on the posterior wall of the duodenum; 20 of these were uncomplicated, 6 were complicated by periduodenitis, 6 by stenosis and 6 by both periduodenitis and stenosis. Among the 20 uncomplicated cases, two ulcers could be seen in 6 cases and one in the other 14. Among the 6 cases with periduodenitis two ulcers could be seen in 3 and only one in 3; among the 6 cases with stenosis two niches could be seen in 2 cases, one niche in 1 and in the other cases even the bulb could not be seen. Among the 6 cases with stenosis and periduodenitis two niches could be seen in 1 case, one in 4 and in 1 case even the bulb could not be seen. Among the total 38 cases of anterior and posterior ulcer, therefore, the double niche could be seen in 12. Among 9 cases of double ulcer in various sites two niches could be seen in 7 and only one in two. Among 11 cases of multiple ulcer two niches could be seen in 2 cases, one in 4 and in 5 cases nothing could be seen on account of the stenosis which often occurs in these cases.

Among the total of 58 cases, double niche was shown in the roentgenogram in a little more than a third. It is somewhat easier to localize double ulcer in the cases with different localizations than in the cases in which there is one on the anterior and one on the posterior wall opposite each other. But cases of the latter kind are much more frequent than the others. Stenosis is more frequent in the cases with multiple ulcers than in those with only two.—*Audrey G. Morgan.*

Comessatti, Giuseppe. Osservazioni radiologiche sulla tubercolosi dell'intestino. (Roentgen study of tuberculosis of the intestine.) *Radiol. med.*, 1936, *23*, 577–620.

Primary tuberculosis of the intestine is quite rare, tuberculosis of the intestine secondary to that of the lung very frequent. The clinical signs are not particularly marked until a late stage of the disease, and roentgen examination is valuable in detecting the involvement of the intestine at an earlier stage when the prospects for treatment are better.

The author studied 35 cases of tuberculosis of the intestine and illustrates them with roentgenograms. Most of these were in patients with pulmonary tuberculosis. The ulcerous form of tuberculosis of the intestine was most frequent, the pseudo-tumoral hyperplastic form second, while tuberculous cicatricial stenosis was rare. The lower part of the ileum and

the cecum were the parts of the intestine most frequently affected, followed in sequence by lesions of the transverse colon, the upper ileum and the sigmoid.

The examinations were made both by contrast enema and contrast meal, the details of the technique being described.

In progressive tuberculosis of the colon there are marked anatomical lesions, such as tubular stenosis, Stierlin's sign, signs of ulceration and polypous proliferation of the mucosa, signs of detachment of the mucosa, changes in the outlines, signs of infiltration of the ileocecal sphincter and shortening of the cecum and ascending colon. In the processes of perivisceritis and mesenteritis which may or may not be associated with lesions in the wall of the intestine itself, the topography of the loops of intestine is more or less decidedly changed; these changes in site and form were most marked in the author's cases in the last loop of the ileum. The differentiation between stenosis due to tuberculosis of the intestine and that caused by external pressure may be made from the fact that in the latter the mucous membrane relief is not changed while in tuberculosis it is markedly changed. The toxins of tuberculosis have a depressing action on the motility and tonus of the intestine, and the emptying time is slowed; these changes are diffuse, however, and it is of perhaps greater roentgen value to recognize slight direct signs of the parietal lesions such as swelling of Peyer's patches, small ulcers, etc. All the devices of modern technique must be used in studying the outline of the individual loops, the mucous membrane relief, etc., including the use of a thin layer of contrast medium and graduated compression. Both direct and functional signs must be considered in the final interpretation of the roentgen picture.

If intestinal tuberculosis can be detected before the stenotic stage and treated with a diet rich in vitamins, ultraviolet radiation, etc., there is hope of cure, though it must be admitted that the primary factor in cure is cure of the lung focus. In every case of pulmonary tuberculosis that is not showing a tendency to heal, a careful clinical and roentgen examination of the digestive tract should be made. —*Audrey G. Morgan.*

GATTI CASAZZA, A., and MUCCHI, L. Studio radiologico delle mesenteriti. (Roentgen study of mesenteritis.) *Radiol. med.*, July, 1936, *23*, 485–521.

The authors describe and illustrate with roentgenograms 18 cases of mesenteritis which they have studied roentgenologically. They were all in the mesentery of the small intestine and almost all were controlled by operation.

Chronic inflammation of the mesentery was not known until the middle of the last century. Virchow was the first to describe it in 1853 as an inflammation with a scanty exudate and a tendency to hyperplasia of the connective tissue followed by retraction and consequent malformation and rigidity of the mesentery. It was differentiated into a circumscribed and diffuse form by autopsy findings. The chief clinical characteristic is pain which is independent of meals and is long continued and of uniform intensity.

The authors find that chronic and sometimes acute mesenteritis shows characteristic roentgen pictures. The signs are due to changes in intestinal tonus in the form either of atony with uniform dilatation or dystonia with dilatation alternating with spasm. These changes are due to chronic or sometimes acute lesions of the blood vessels and nerves of the mesentery.

The picture of mesenteritis is rarely found alone. Generally it is accompanied by other lesions, such as appendicitis, cholecystitis, perivisceritis, etc. The roentgen picture of chronic mesenteritis is rare as compared with the cases found on autopsy, probably due to the fact that in many cases the inflammation spares the vessel nerve arches of the mesentery.

In segmental atonic dilatation the flattening of the valvulae conniventes as described by Vespignani is not constant but may change in the same patient in the course of a few hours. The absence of stenosis below the atonic dilated portion is of great value in differential diagnosis. A frequent sign to which too little attention has been paid heretofore is the increased time required for the contrast medium to pass through the jejunum and ileum.

It is possible for these lesions to be diagnosed from the few clinical signs that they cause but roentgen examination is required for confirmation. One point that is of special interest in roentgen examination is the detection of slight and circumscribed lesions masked by other diseases of the intestinal tract, the symptoms of which are sometimes modified by the mesenteritis.—*Audrey G. Morgan.*

Gutmann, René A., and Rekis, S. Quelques cas de lithiase du pancréas. (Some cases of lithiasis of the pancreas.) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1936, *24*, 185–188.

The authors present 5 cases of lithiasis of the pancreas which they had the occasion to observe. The condition is less rare than one would surmise but, as a rule, it passes unnoticed due to various clinical and roentgenological reasons. From the roentgen standpoint these reasons are multiple: The calculi, as a rule, are more transparent to the roentgen rays than most of the biliary or renal calculi; they often appear small; they may be covered by the stomach shadow and if they are localized to the body and tail of the pancreas, they may project to the left of the greater curvature, a region which one is apt to overlook even more frequently than the duodenal frame.

In 4 of the 5 cases presented, the calculi were multiple and absolutely typical both from the roentgenologic and clinical standpoint. The fifth case is still under study and it appears that there is a solitary calculus obstructing the Wirsung canal.

In the discussion which follows this presentation, Béclère states that he for the first time noticed a case of pancreatic calculus in 1919 when a patient was referred to him who already had been roentgenographed more than forty times. There was evidence on most of these roentgenograms of an abnormal calcification in the region just a little to the right of the transverse process of the third lumbar vertebra. The first diagnosis was that of a renal lithiasis and the patient was subjected to a renal exploration with negative results; then the diagnosis was changed to that of biliary calculi and a second operation was performed, likewise with negative results. At this time the patient came under Dr. Béclère's observation and a diagnosis of pancreatic lithiasis was made, and finally a third operation revealed the presence of calculi of the head of the pancreas. Following removal of these stones there was a very marked improvement in the condition of the patient, but six months later new calculous shadows appeared. A re-examination one and a half years later, when the patient again complained of intolerable pain, revealed the presence of numerous stones occupying the entire region of the head of the pancreas. Since that time the author has observed 5 other cases, a fact which proves that the condition is not altogether rare.—*T. Leucutia.*

GYNECOLOGY AND OBSTETRICS

Rossi, Armando. Il contributo della radiologia nella diagnosi della sterilita femminile. (Contribution of roentgenology to the diagnosis of female sterility.) *Ann. di radiol. e fis. med.*, Feb., 1936, *10*, 1–52.

This is a lengthy article dealing with the value of roentgen investigation by means of opaque media in female sterility. The method used by the author is that employed generally, with a few personal modifications. Thus 15 to 25 per cent iodoleum is used with preference in quantities of 2 to 3 c.c., which is injected intrauterinely under very low pressure. The first observation is made with the cervix closed, that is, with the obstructing cannula in position, several serial roentgenograms being made at one to two minute intervals. Then the cannula is removed and the examination is continued with the cervix open, roentgenograms being made at ten to fifteen minute intervals. In cases of particular interest the examination is repeated even after 12, 24 and 48 hours.

On the basis of numerous cases, the serial roentgenograms of many of which are included in the text, the following general conclusions are reached: The diagnosis of female sterility cannot be considered complete without the aid of roentgen examination and no rational treatment can be instituted without its control. The most valuable method for this purpose is hysterosalpingography which gives precious information in many instances of sterility of uterine origin and especially in those associated with tubal alterations. In the sterility of uterine origin, hysterosalpingography permits the demonstration and the clinical evaluation of anomalies of development, malformations, anomalies of position, and intrauterine tumors. In these latter, hysterosalpingography besides leading to very accurate localization of the site of the tumor, allows at the same time certain conclusions concerning the mechanical and functional (atony and hypertony) disturbances of the tubes. In sterility due to tubal alterations, hysterosalpingography permits, above all, the estimation of the permeability of the tubes and a number of other affections which may vary from partial permeability caused, as a rule, by anatomic changes to the relative stenosis essentially of functional origin

and finally to complete obliteration which may be diffuse or localized. Furthermore, hysterosalpingography permits the individualization of the various forms of stenosis and the study of their evolution. In other instances it is possible to determine the anatomic state of the tubes and the complications which follow the various affections. In chronic salpingitis the method permits the estimation of the integrity of the tubal walls, whereas in cystic dilatation one may establish whether this is simple (valvular form of cystic salpingitis) or associated with perisalpingitis (chronic cystic salpingitis) or already transformed into pyosalpingitis.

By studying the serial films from the point of view of pathogenesis of the sterility in the cases of tubal origin, the author was able to demonstrate that in many instances the variation in the roentgen appearance represented nothing more than various phases of the same affection.—*T. Leucutia.*

LAMARQUE, PAUL. L'historadiographie; nouvelle technique d'examen des coupes microscopiques. (Historoentgenography; new technique of examination of microscopical sections.) *Presse méd.*, March 21, 1936, *44*, 478–481.

Goby, in 1913, had already obtained roentgenograms of small objects and insects by utilizing radiation of very little penetration. In 1925 he published stereoscopic views of the same subjects. This method, however, does not differ materially from the ordinary roentgenographic technique and in consequence the research remained of limited value.

The author recently became interested in the problem whether or not one could use the roentgen rays for the study of the cell and its constituents. Individually the problem encounters numerous difficulties, chief among which are: (1) the small size of the object to be examined and (2) the slight density of the bodies which enter into its composition. To overcome the first it is necessary to obtain very thin sections so as to be able to distinguish the various cellular elements. In making a roentgenogram of such a section one must bear in mind that the image does not represent an ordinary photograph but a shadow which is very similar to a Chinese shadow except that it is more complicated. For the second, that is, to be able to visualize very slight variations in density, it is necessary to use soft roentgen rays of rather long wave length. It is the author's experience from the work done so far that roentgen rays of 2.5 Å lead to the best results, although the utilization of such soft rays is greatly complicated by the fact that the rays are so soft that they cannot penetrate the glass wall of an ordinary tube and even if they were able to do this they would be completely arrested by a few millimeters of air.

In 1930, Dauvilliers succeeded for the first time in making a roentgen microphotograph of a vegetal section and it is this work which incited the author to pursue the research with historoentgenograms of animal cells. Because of the more complicated situation, the author was forced to considerably modify the technique of Dauvilliers and step by step he arrived at results which are now worth while for publication.

One of the chief modifications consists in the construction of a tube especially adapted for the purpose. This tube is demountable, has a tungsten anticathode, is cooled by circulating water and connected to ground. Laterally it supports a photographic chamber which is in direct communication with the body of the tube by a special canalization. This chamber is separated from the anticathode by a conical window to which is adapted a metallic cork, pierced on its axis and supporting a filter, designed to arrest the cathode rays which might impress the film. The choice of the filter is of great importance; it is usually only a few microns thick and made either of cellophane or of a very light laminated metal. A vacuum is made in the tube and photographic chamber at the same time. The section to be examined is stuck on a photographic plate either by alcohol or water and is removed either before or after the development of the plate. If one uses very thin sections, they may be left adherent to the gelatin without inconvenience. The roentgen exposure is obtained in five minutes with 5 kv. and 80 ma.

The roentgen plates so obtained are then either enlarged or examined under the microscope. Since the grains of the emulsion in the ordinary plates may interfere with the clarity of the view it was found necessary to make special plates with an emulsion which contains exceedingly fine grains. The solution of this problem for awhile represented great difficulty but at the present time the author is able to produce in his own laboratory emulsions of such fine quality that the grains appear invisible during the magnification. The technique

of manufacture of the emulsion as well as that of the actual taking of plates will be published in extenso in a later article.

The results obtained so far are very encouraging. The images of course represent negatives and therefore they might produce some embarrassment to the eye accustomed to look at straight histologic sections, but after a little experience and especially when comparing the historoentgenogram with regular colored microscopic sections the eyes soon become used and a fair interpretation may be given. In this article the author reproduces eleven historoentgenograms of various tissues such as section of the skin, malpighian layer, prostate, striated muscle and papilloma, all of which represent unusually clear views. It will remain for the future to determine the new data or information which may be gained through such an examination. One example will suffice to illustrate its value: It was found, for instance, that at a great enlargement (300 D) definite granulations appear in the cytoplasm due to heterogeneity. This cytoplasm surrounds a more or less rounded, very transparent area which corresponds to the nucleus. In other words, the nuclear content is very poor in elements of heavy atomic weight, representing, in fact, the most transparent area of the entire section. This is contrary to what was thought until now since the nucleus represents in a colored section the densest and best colored area; thus it appears that while it actively takes the stains it must be composed of elements of very light atomic weight. Furthermore, within the nucleus there is a small spot of very great opacity, in fact representing the greatest opacity in the entire section. There can be no doubt that this spot corresponds to the nucleolus, a constituent which again was formerly assumed to be rather light and which now appears to contain elements of heavy atomic weight. On the other hand, whereas the nucleus appears rather homogenous on very great enlargement, the nucleolus shows in its center a more or less regular zone of maximum opacity.

The conclusion is reached that historoentgenography represents a method which will open a new chapter in microscopic technique in the same sense as the methods by staining or fluorescence. According to the author's belief, this method is even richer since it permits the utilization of other chemical agents than stains, and certainly deeper since it allows a study of the very fine structure of the cellular elements. Finally, it will be possible in the near future to obtain with a slight modification of technique, historoentgenograms of living non-fixed tissue.—*T. Leucutia.*

GENITOURINARY SYSTEM

Vaughn, John N. Intravenous urography. *Texas State J. Med.*, March, 1936, *31*, 677–679.

The author discusses the principles and technique of intravenous urography, and considers the following states as contraindications to its use: (1) severe renal and hepatic insufficiency; (2) active pulmonary tuberculosis; (3) thyrotoxicosis; (4) iodine idiosyncrasy, and (5) children with exudative diathesis. The procedure is considered acceptable in: (1) renal ptosis; (2) renal tuberculosis; (3) hydronephrosis; (4) abdominal tumors; (5) renal lithiasis; (6) polycystic kidney, and (7) upper urinary tract anomalies.—*W. R. Brooksher.*

Guilleminet, and Gayet, Robert. Le diagnostic des calculs du rein et de l'uretère chez l'enfant; à propos de trois cas. (Diagnosis of calculi of the kidneys and ureter in children; report of 3 cases.) *Presse méd.*, March 18, 1936, *44*, 451–454.

The authors recently had the opportunity of studying 3 cases of renal and ureteral stones in children. In the present article the 3 cases are described in detail and illustrated with roentgenograms. As regards the diagnosis, it is stated that in addition to demonstration of blood in the urine, roentgenography is of the greatest importance. In most instances it is possible to demonstrate the stones by flat films but it is recommended that this always be supplemented by intravenous pyelography. The authors employed uroselectan B in a 75 per cent solution, the injected amount being 15 grams which is mixed with 10 per cent glucose. The method has proved without inconvenience and it has the following advantages: It is very rapid, within one hour after injection the examination being completed; it has no accidents due to intolerance; there is only very slight pain; very accurate information is gained on the size and situation of the stones, and finally additional information is obtained concerning the anatomic as well as the functional state of the kidneys, pelvis and ureters.

After reviewing the cases of stones occurring in children as collected from the literature, the authors raise the question as to whether or not many of the cases encountered in the adult have not had their origin in childhood, the stones having remained undetected for a long while because of lack of symptomatology. At any rate the literature reveals that stones in the urinary tract occur more frequently in childhood than is suspected.—*T. Leucutia.*

SKELETAL SYSTEM

BENASSI, ENRICO. Sull'aspetto radiologico e sulla fisioterapie delle artriti e spondiliti da febbre ondulante. (The roentgen appearance and physiotherapy of arthritis and spondylitis caused by undulant fever.) *Radiol. med.*, Sept., 1936, *23*, 686–694.

Undulant fever may cause acute, subacute or chronic arthritis; the most frequent localization of this arthritis is in the spinal column. The author describes one case of this form of arthritis of the wrist joint and hand and 3 cases of undulant fever spondylitis. The clinical symptoms are such that the latter may be confused with Pott's disease, and the roentgenogram is of value in differentiatiating this condition from tuberculous arthritis.

In the case of arthritis of the wrist, the roentgenogram showed quite an intense diffuse atrophy of the bones, the changes being chiefly in the spongy tissue. There was rarefaction but the trabecular design was preserved. The bone cortex was thinned but not broken at any point. In the cases of spondylitis the roentgen changes were rather mild; the destruction was slight in degree and not very extensive; it was sharply circumscribed and there was no reactive bone atrophy around it. Even at a late stage, reactive hyperostosis and osteosclerosis were not very marked and there was practically no change in the intervertebral discs. The roentgen picture was quite different from that of tuberculous spondylitis. In spite of the slight bone lesions, however, there was very severe pain, particularly on pressure over the spinous processes of the affected vertebrae, and marked rigidity.

Another point, both in treatment and in differentiation from tuberculosis, is that this form of arthritis is very favorably affected by heat treatment, particularly diathermia and Bier's baking.—*Audrey G. Morgan.*

SPÉDER. L'ostéopétrose généralisée au "marmorskelett" n'est pas une maladie rare; sa fréquence dans l'intoxication fluorée. (Generalized osteopetrosis or "marble skeleton" is not a rare disease; its frequency in fluorine intoxication.) *J. de radiol. et d'électrol.*, Jan., 1936, *20*, 1–11.

In January, 1935, during an amateur bull fight, a man forty-four years of age, while forcibly holding the bull, suffered a violent pain in the left shoulder. Roentgenographic examination demonstrated a fracture of the scapula and at the same time a marked condensation of all of the bones shown in the film. Further study revealed that the condition was generalized, the patient suffering from an osteopetrosis or ivory skeleton.

The first impression was that the lesion may represent a case of Albers-Schönberg's disease, an affection which is exceedingly rare. But in Maroc, where this study was made, there are a number of animals affected by a similar condition, the most noteworthy findings being a peculiar spotting of the teeth and hyperostoses in various parts of the skeleton. With this as a starting point, it was found that in the said region, several humans otherwise known as normal, likewise showed dental changes. Roentgenograms on some of these men taken at random invariably revealed skeletal changes characteristic of osteopetrosis.

The author arrives at the following conclusions concerning the above-said malady: (1) Generalized osteopetrosis is not a rare affection. Thousands of cases may be discovered if one considers individuals subjected to intoxication by fluorine and especially by calcium fluoride (alimentary, aqueous, industrial, medicinal intoxication). For this reason one may differentiate between osteopetrosis as a malady proper and osteopetrosis as a symptom. (2) The osteopetrosis is more or less generalized and is encountered chiefly in the phosphatic regions of Maroc, but it is also observed in Sweden in a cryolite factory (in 30 out of 78 workers). The condition was repeatedly described in domestic animals (goats, horses, cattle) subjected to fluorine intoxication, as, for example, in Iceland after volcanic eruptions, the United States, South Africa, the Argentine, etc. (4) In administering fluorides by food or drink experimentally it was possible to reproduce the above-said changes. (5) It is probable that osteopetrosis encountered in infants

is due in some cases to unrecognized intrauterine fluorine intoxication. (6) The parathyroid glands seem to have no influence on the development of osteopetrosis. (7) Calcium fluoride creates osteopetrosis by being a hypercalcifying toxic agent; under similar circumstances it may be used rationally in treatment of other affections.

A bibliography of 28 articles is appended.—*T. Leucutia.*

Spéder, E. L'ostéopétrose de la fluorose phosphatique de l'Afrique du Nord. (The osteopetrosis of the phosphatic fluorosis of the North of Africa.) *Bull. et mém Soc. de radiol. méd. de France*, March, 1936, *24*, 200–207.

The author observed, in the phosphatic regions of Maroc, osseous lesions consisting chiefly of hyperostosis, with condensation of the bone and usually terminating as a generalized osteopetrosis or ivory skeleton. These modifications were observed only in subjects affected with "darmous," an Arab term used for a lesion characterized by a dental dystrophy of of animals and humans who lived in the phosphatic zones until the eruption of their permanent teeth. Dr. Velu (a veterinarian) was the first to study the problem of darmous and he established a definite relationship between this affection and the consumption of water which traversed the phosphatic layer. Thus he arrived at the conclusion that darmous represents a chronic intoxication by fluorine inclosed in the phosphates and absorbed especially in the form of calcium fluoride. By enlarging the observations of Velu, the author was able to demonstrate that the same condition occurs in the human living in the phosphatic zones.

The individual affected with darmous first shows dental dystrophies which are quite typical (see above abstract). To these localized dental disorders which first were thought to be the only pathologic clinical manifestations of darmous, one may now add the skeletal modifications which, according to the author, are observed in 100 per cent of the individuals affected. It is interesting that in none of the cases observed was there any evidence of epiphyseal deformity, signifying a process of childhood which might have modified the growth or form of the diaphyso-epiphyseal cartilage. There is, however, an exaggeration of transverse and logitudinal over-development of the inferior extremity of the radius, the styloid process of which descends a little lower than normally. Up to the age of twenty-one to twenty-five, this forms the only osseous modification except perhaps a calcium deposit at the level of the muscles of torsion of the arm, the external aspect of the humerus appearing irregular and there being a bony overgrowth which extends about 1 to 1.5 cm. above the surface.

Above twenty-five years, the skeletal modifications vary according to the different types of intoxication. Thus in the more massive and acute cases the fluorosis leads to periosteal and tendinous osseous proliferations which ultimately show a tendency toward marmorization. In the more chronic cases the fluorosis produces a thickening of parts of the skeleton due to irregular osseous deposits of a centrifugal or centripetal cortical origin, followed by a disappearance of the trabeculae and finally by a generalized opacification showing a veritable marmorization. In order of importance the osseous proliferations appear at the superior part of the interosseous tibio-fibular space and then of the radio-ulnar space in the form of osseous stalactites, with multiple points of orientation which correspond to the direction of the fibers of the interosseous ligaments.

At the age of thirty-five, areas of ossification in the form of parrot-beak appear at the superior and inferior borders of the lumbar vertebrae very similar to the osteophytes of ossifying spondylitis.

Between the ages of thirty-five and forty years osseous deposits of cortical origin appear on the iliopectineal crest, superior aspect of the ischiatic process with narrowing of the obturator foramen and, finally, some flattening of the cotyloid cavity of the coxofemoral joint, although the joint itself remains of normal appearance and the articular cartilage intact.

Towards the age of forty-five a thickening of the lower ribs with narrowing of the intercostal spaces appears and finally the process becomes more and more generalized leading to osteopetrosis of practically the entire skeleton.

One may mention that in subjects between the ages of forty-five and fifty very extensive calcareous incrustations of the arches and of the lymph nodes is observed not infrequently.

It would be interesting to carry out similar observations in the phosphatic zones of Algeria and Tunis to determine whether the modifications are identical to those observed in Maroc.

This then would establish beyond doubt the rôle of fluorine as an etiologic agent.—*T. Leucutia.*

Spéder, E., and Fournier. Étude radiographique des lésions osseuses du darmous ou fluorose des régions phosphatées du Maroc. (Roentgen study of osseous lesions of darmous or fluorosis of the phosphatic regions of Maroc.) *J. de radiol. et. d'électrol.*, March, 1936, *20*, 116–122.

This article constitutes one of the papers in a symposium on the roentgen examination of pathology of endocrine glands as presented to the Second Congress of Electroradiologists of the French Language in Brussels, 1935. It includes partly what was said in the two above articles concerning the nature of darmous and the rôle of fluorine as a provoking agent. Then the paper deals in extenso with the roentgen appearance of the osseous changes by describing the modifications observed in every bone of the skeleton in detail and by using several roentgenograms for illustration of the characteristic appearances. The conclusion is reached that fluorosis of the phosphatic regions of Maroc produces important changes of form, structure and opacity of the bone. These changes are due (1) to the centrifugal osseous proliferations of periosteal and tendinous origin (in the young subjects and those affected by a relatively acute intoxication); (2) to centrifugal and centripetal osseous deposits of cortical origin leading to a thickening of the bone and narrowing of the caliber of the medullary canals and the natural cavities of the skeleton (sinuses), and (3) to a thickening and then a disappearance of the osseous trabeculae which fuse into a marmor-like mass. The osteopetrosis of darmous appears the more complete the fewer periosteal and tendinous proliferations the skeleton presents. The osteopetrosis corresponds beyond doubt to a slow intoxication by ingested fluorine in very small doses under favorable alimentary conditions (calcium) and extending over a very long time (subjects from forty-five to fifty-five years). (4) Very rarely to the appearance of limited zones of rarefaction of the cranium, especially in the subjects in which the calcium supplied was deficient during some period of evolution.

In none of the cases affected with darmous, even with generalized petrous skeleton, was there evidence of premature calcification of the costal, articular or intervertebral cartilages. Likewise, there never was evidence, even when darmous started in early childhood, of any epiphyseal modifications signifying atrophic influence on the cartilages of conjugation.

The osseous lesions of darmous observed in the human are comparable to those observed in fluorosis of animals and in occupational or alimentary fluorosis of humans, the variation being due simply to the mode, intensity and duration of the intoxication by the fluoride salts.—*T. Leucutia.*

Colale, Gaetano. Un caso di sindrome scafoidea del Köhler e sua probabile interpretazione patogenetica. (A case of Köhler's scaphoid syndrome and its probable cause.) *Radiol. med.*, July, 1936, *23*, 540–545.

There is a great deal of difference of opinion in regard to the cause of Köhler's disease of the scaphoid, which occurs in children between five and ten years of age, in the majority of cases in males. It has a very characteristic roentgen picture. The scaphoid is reduced in size as compared with the other bones of the foot, which are normal. It is flattened anteroposteriorly in the form of a biscuit with dentate outlines. The spongiosa is much denser than normal and the normal arrangement of the trabeculae cannot be seen. The density of the central part of the bone is greatly increased and it is almost metallic in appearance. The prognosis of the disease is good; generally after one to two years the bone is completely restored to normal.

The author describes a case in a girl five years of age. The father was living and well. The mother and a maternal aunt had died of tuberculosis. About a month before admission to the hospital the child was struck on the foot by a stone. The next day the foot was swollen and the child complained of pain in the tibio-astragalic joint. She had irregular fever for a few days. There was a certain amount of limitation of all active movements. After some time a physician was called who diagnosed abscess and made an incision on the back of the foot; a small amount of purulent matter mixed with blood was discharged. The wound did not heal and a fistula remained. When she came for examination there was slight enlargement of the peripheral lymphatic glands. The foot was swollen and arched more than normal and there was a draining fistula on the back of it. Active and passive movements were limited. The roentgen examination showed the char-

acteristic picture of Köhler's scaphoid disease. The Wassermann reaction was negative, the Pirquet reaction intensely positive.

The author believes that in this case, at least, the disease was tuberculous in origin and that the trauma was merely an exciting cause. —*Audrey G. Morgan.*

Baumgartner, Jean, and Berthoud, Francis. Raréfaction osseuse post-traumatique chez une jeune femme ovariectomisée; guérison par injections d'extraits ovariens. (Post-traumatic rarefaction in a young ovariectomized female; cure by injections of ovarian extracts.) *Presse méd.*, March 21, 1936, *44*, 495–496.

It is generally accepted, since the publications of Leriche and Policard, that the skeleton represents a great calcium reservoir which is mobile under the primary influence of vasomotor alterations of the circulation. This conception led to the doctrine of post-traumatic osteoporosis, the traumatism forming, in certain cases by habitual consecutive hyperemia, the major factor of the syndrome. Obviously not all osteoporoses are of traumatic origin, as, for example, the osseous rarefaction due to gonococcic infection, tuberculosis, tabes, etc., but it is probable that even the traumatic group includes certain cases of other more obscure origin in which the trauma may be of only secondary importance. The authors observed such a case in 1934 in a young woman who, as a result of a minimal trauma, developed a severe osteoporosis of the bones of the leg complicated by a spontaneous fracture at the superior extremity of the tibia and fibula. This woman had undergone total castration eight years previously and has shown since then definite manifestations of ovarian insufficiency. Following the administration of ovarian extract in the form of subcutaneous injections, there was a good healing of the fracture with complete disappearance of the osteoporosis. It is the authors' opinion that the traumatism in this case provoked a vasomotor disequilibrium which then resulted in osteoporosis. The fact, however, that the endocrine therapy alone led to complete clinical and roentgen cure proves that the ovarian deficiency must have played a primary rôle during the abnormal duration of the vasomotor disorder. It thus appears that the influence of certain endocrine glands, such as the ovary, on the vasomotor phenomena must be admitted. If such a condition exists, a minimal trauma may represent the provoking factor of the osteoporosis, limiting it as a rule to that part of the skeleton where the trauma has occurred.—*T. Leucutia.*

BLOOD AND LYMPH SYSTEM

Teneff, Stefano, and Stoppani, Franco. A propos de la lymphographie. (Concerning lymphography.) *J. de radiol. et d'électrol.*, Feb., 1936, *20*, 74–77.

In a previous article (see abstract, this Journal, Feb., 1934, *31*, 286) the authors described their method for the roentgenographic study of the lymphatic circulation and lymph nodes in the living. Since that time the experiments have been continued. In this article, after a brief argumentative historical review, the authors, without entering into technical details, reiterate the value of the method which in the main is as follows: The subcutaneous and subaponeurotic tissues of the sole and dorsum of the foot of animals (guinea pigs, rabbits, dogs, etc.) are injected with thorotrast or toriofanine. Then the animals are allowed to walk and roentgenograms are made at intervals of 10, 15, 20 and 30 minutes, 1, 2, 3, 6 and 12 hours. On these serial roentgenograms one soon notices the absorption of the injected opaque medium by the lymphatic vessels and the subsequent passage to the regional lymph nodes. It is noted that five days after the injection the lymphatic vessels appear free of the opaque medium but the lymph nodes become increasingly more opaque, the opacity being noticeable even two months after the injection.

By this very simple method it is possible to obtain roentgenograms of the entire lymphatic system of a limb or a region by visualizing the lymphatic network from its origin to the regional glands with all anastomoses, including the efferent vessels of the lymph nodes. In contradistinction, the method of Gerota appears more complicated since it is necessary to expose surgically the lymph nodes into which the opaque substance is injected. Furthermore, by this latter method only one single lymphatic trunk is visualized from the injected lymph node to the next in the lymphatic chain.

In the *Boll. e. mem. Soc. Piemontese di chir.*, in 1934, the authors published the results of their studies on the lymphatic circulation after extirpation of lymph nodes. These experiments have proved beyond doubt the great possibility of the lymphatic circulation to re-establish

itself through collateral or newly formed vessels even in case that large lymphatic systems are interrupted, which under normal conditions would supply the entire region. In another article which appeared in the *Radiol. med.*, in 1935, the authors published the effect of small, medium and large doses of roentgen rays on the lymphatic circulation and vessels. Here, too, it was demonstrated that the permeability of the lymphatics is completely maintained even when there is marked anatomic destruction present. At the present time work is being carried out by Lucca on the status of the lymph nodes in case of inflammations. In this respect a variation was noted in the lymphatic vessels of living and dead animals.—*T. Leucutia.*

MOREL-KAHN and BERNARD, JACQUES. A propos de la lymphographie. (Concerning lymphography.) *Presse méd.*, March 7, 1936, *44*, 383.

During the past four years repeated attempts were made to inject the lymphatics in the living for the purpose of roentgen study. Various opaque solutions were used for this purpose, most authors finally arriving at the adoption of thorium salts, and especially thorotrast, as the best medium. The injection is made with a very fine needle and under great pressure; however, it is not necessary that the needle be introduced into the lymphatic vessels proper since a good absorption of the opaque substance is obtained from a simple injection of the subcutaneous tissues or serous cavities.

The procedure has permitted in animals the roentgenography of the limbs, thoracic duct and the lymphatics of the tongue, as well as a study of the lymphatic absorption from various serous cavities. In the human, the method has found some physiological and even physio-pathologic applications. It has permitted the demonstration of the acceleration of the lymphatic circulation under the influence of muscular contraction. It has made possible the estimation of the development of lymphatic anastomosis after the ligation of the principal trunk, particularly of the thoracic duct. Then it has allowed the study of the influence of sympathectomy on the re-establishment of lymphatic circulation. Finally, by injecting the peritoneal or pleural cavities, it has permitted a study of the lymphatic absorption, and, by injecting (with lipiodol) the cervical glands in tuberculinized animals, it has made demonstrable the passage of the lipiodol into the substernal, tracheobronchial and pulmonary glands. As a clinical method, however, lymphography has as yet little application and it appears that its use is not without danger. From studies of thorium injections in connection with the roentgen visualization of other organs such as liver, spleen, bone marrow, blood, etc., it was found that this danger may be attributed to various things. Thus if the injection is made intravenously an immediate colloidoclasic shock may develop, although this is usually of transitory nature. The obstruction of the reticulo-endothelial system by the colloidal grains has never led to a complete blockage of this system and the various functional tests reveal that the phagocytosis continues to remain independent of the amount of thorium injected; yet, the extremely slow elimination of the thorium may have some deleterious effect, due chiefly to the radioactivity of the thorium, however small this may be. It was possible to demonstrate even three years after the injection the presence of thorium in the liver in hepatography. Several years of research are necessary before this part of the problem may be settled.—*T. Leucutia.*

ROENTGEN AND RADIUM THERAPY

BÉCLÈRE, ANTOINE. Das Seminom des Hodens und des Ovariums. (Seminoma of the testicle and ovary.) *Strahlentherapie*, 1934, *50*, 597–610.

In this volume, which is dedicated to the memory of Albers-Schönberg, the author calls attention to the fact that the excellent results of roentgen treatment in seminomas of the testicle and ovary are due to the experimental work of that great roentgenologist.

The author himself, for the first time in 1905 and the second in 1907, found that he was able to cure intra-abdominal metastases after the surgical removal of tumors of the testicle with very small doses of unfiltered roentgen rays. In the first case, the result was only temporary; in the second the patient left his treatment eleven months after the complete disappearance of an intra-abdominal tumor the size of an orange.

These tumors are epithelial tumors originating from the spermatogonia and are therefore called seminomas. The extraordinary radiosensitiveness of these tumors is due to the slight differentiation and therefore great radiosensitiveness of the cells of which they are

made up, that is, the epithelial cells of the seminal tubules. The best method of making an early diagnosis and following up cure in these cases is by the demonstration and quantitative measurement of prolan A in the urine.

Seminomas may also occur in the ovary. In the early stage of its development, what may be called the hermaphrodite stage, the genital gland is made up of a central germinative epithelium and a peripheral cortical epithelium. The central layers form the testicle while the cortical epithelium, after a series of changes, forms the ovary. But genital glands occur, mostly ovaries, in which both forms of epithelium have developed and produced a hermaphrodite gland.

Generally ovarian seminomas have been discovered only after surgical removal and histological examination. They occur, as a rule, at the beginning of sexual life, though sometimes much later. Abnormally early occurrence of menstruation, irregularity or absence of the periods in young women, malformations of the internal genitalia, anomalies of the secondary sexual characteristics and perversities of the sexual impulses suggest the possibility of such tumors. The symptoms do not differ from those of other solid tumors of the ovary.

The author knows of only 2 cases of seminoma of the ovary that have been treated by roentgen therapy and demonstrated histologically; these are described, together with a number of others in which the histological diagnosis was not made. All of them show the extraordinary roentgen sensitiveness of seminomas.

The important point in the treatment of seminomas is early diagnosis. In young women with solid ovarian tumors the excretion of prolan A in the urine should be tested and measured, especially if there are any of the above-mentioned signs that suggest the possibility of seminoma. If the reaction is positive, roentgen treatment should be given before operation is performed. After operation, if histological examination shows seminoma and there is danger of the operation having been incomplete, prolan A excretion should be followed up during the whole course of roentgen treatment.—*Audrey G. Morgan.*

VOGT, E. Hydrometrabildung nach postoperativer Radiumbestrahlung wegen Ovarialkarzinom. (Development of hydrometra after postoperative radium irradiation for carcinoma of the ovaries.) *Strahlentherapie*, 1934, *50*, 683–686.

The author describes a case in a woman of thirty-three who was operated on for bilateral carcinoma of the ovaries. The adnexa on both sides were extirpated. Two weeks after the operation she was irradiated with the full carcinoma dose of roentgen rays; four months later she was given another carcinoma dose and also irradiation with 1,800 mg-hr. radium in the uterus and 400 mg-hr. in the vault of the vagina. The patient's general condition was good and she was absolutely free of symptoms.

She came back for reëxamination several times. When she returned after almost two years she complained of swelling of the abdomen. The uterus was found the size of a man's fist, hard, not painful on pressure, movable only with difficulty. This suggested myoma of the uterus or possibly a metastasis of the ovarian carcinoma. Laparotomy showed hydrometra. The uterus was extirpated. She was given another full carcinoma dose of roentgen irradiation after the operation. Up to the present time, more than three years after the first operation, she is completely free of symptoms.

Hydrometra is an unusual complication of intrauterine radium treatment. The case shows that good results can be obtained by combined roentgen and intrauterine radium treatment after operation—*Audrey G. Morgan.*

VIDAKOVIĆ, S. Roentgen und Radiumbehandlung maligner Geschwülste der weiblichen Genitalorgane und ihre Komplikationen. (Roentgen and radium treatment of malignant tumors of the female genital organs and their complications.) *Strahlentherapie*, 1934, *51*, 300–304.

The author discusses the results of his use of roentgen and radium treatment at the University Gynecological Clinic of Agram since 1923. He divides it into two periods, from 1923 to 1930, when they used only roentgen irradiation, and the years 1931 and 1932, when they had radium available.

In the first period all operable tumors were first operated on and then irradiated, while only inoperable cases were given irradiation alone. During this period 696 cases of cancer of the cervix were treated; of these 325 were operated on radically by the methods of Wertheim or Schauta. Of these cases operated on and then irradiated 147 (45.2 per cent) re-

mained well and free of symptoms for over three years. In the inoperable cases, treated by irradiation alone, the results were very poor. Out of 238 cases only 1 was alive and completely free of symptoms after five years. In 5 cases the infiltration in the parametrium was decreased to such an extent that they became operable. Clinical improvement for one to three years was brought about in only one-fourth of the cases. In this group there was 1 case of inoperable vaginal carcinoma which was so much reduced by roentgen irradiation that operation could be performed and the patient is completely well after nine years. The cause of these poor results is doubtless that these were all far-advanced inoperable cases; also that they had no radium but had to use roentgen rays alone. In 1 case of inoperable sarcoma in which the patient's condition was so desperate that treatment hardly seemed worth while the patient recovered completely and has remained well for over five years.

During the same period 66 cases of cancer of the body of the uterus were treated, 38 of them between 1923 and 1928. Of these 18, or 47.37 per cent, are well after more than five years; 23 were treated in 1929 and 1930; of these 17, or 60.7 per cent, are well after three years, or a total for the whole group of 35, or 53 per cent.

In carcinoma of the vulva, electrocoagulation is particularly valuable as almost the whole vulva can be removed in this way without loss of blood. The figure for absolute cure in this group of cases was 15.78 per cent. Since radium has been available it has been used in the form of molds or radium puncture; when the tumor recedes enough after radium treatment to become operable, the treatment is continued by operation and roentgen irradiation. In completely inoperable cases, only transitory results were obtained by radium and roentgen irradiation.

The time has not been long enough since radium was available to give permanent results. In 1931 and 1932, 12 cancers of the cervix were given radium treatment alone; of these 6, or 50 per cent, are well for one to two years. Among the 279 cases of carcinoma of the cervix admitted, 267 were given radium treatment. Among 133 cases treated in 1931, 34, or 25.5 per cent, are at present living and free of symptoms, of the 134 treated in 1932, 40, or 29.8 per cent, are living and well.

The first year the radium was applied by the Stockholm fractional method two or three times and roentgen irradiation begun one to two weeks later: two abdominal and two sacral fields, 15×15 cm., 40 cm. focus-skin distance, 0.6 mm. copper and 0.5 mm. aluminum filter, 180 kv., 4 ma., 800–1,000 r to each field. With this method there was 1.5 per cent mortality. During the second year in some cases a single protracted application by Regaud's method was used. Among the 134 patients treated in this way 5 died, a mortality of 3.7 per cent. Of these, 2 were at the limits of operability. In the total of 267 cases treated with radium there were 7 deaths, or 2.6 per cent. The cause of death in 6 cases was pyosalpinx followed by peritonitis. In only 1 case after a single brief application there was complete anuria. This was a carcinoma Stage IV. The greater mortality in the second year it is believed was due to other factors and not to the fact that a single application was used instead of the fractional method. The author emphasizes these cases to show that radium treatment does have a certain mortality. It is often urged as one of the advantages of irradiation that it does not have any primary mortality.

In order to reduce the complications of radium treatment to a minimum the author recommends the following plan of treatment: When the blood sedimentation reaction is normal, the adnexa completely free and the tumor not very necrotic, intrauterine and vaginal application of radium is used, by the Stockholm or Paris method, depending on the individual case. If the sedimentation rate is increased and there is a high leukocytosis or inflammatory changes in the adnexa, the radium is applied only vaginally to the tumor. If this causes a high temperature reaction, roentgen irradiation is used first, followed by radium. If it is a large tumor, it should be removed first by electrocoagulation and radium applied six to eight days afterward.—*Audrey G. Morgan.*

KORCHOW, W. I. Beiträge zur Frage über die Komplikationen nach Radiumbehandlung der Geschwülste der Harnblase und der benachbarten Organe. (Complications after radium treatment of tumors of the bladder and neighboring organs.) *Strahlentherapie*, 1934, *51*, 164–178.

The author describes 3 cases and illustrates them with photomicrographs of the histological findings. He concludes that differential diagnosis of cancer of the prostate is very difficult

unless hypertrophy of the prostate, which is very frequent in old people, can be definitely excluded. Cystitis resulting from hypertrophy of the prostate is a serious obstacle to the success of operative treatment, particularly if it is followed by radiotherapy. If there is inflammation of the bladder wall or it has been injured by radiotherapy, operation is apt to be followed by severe infectious-necrotic complications. The use of radium therapy in cases of radionecrosi sis contraindicated and treatment must be limited to the infection which complicates such necroses.

Diagnosis of the nature of tumor of the prostate cannot be made by cystoscopy alone without examination of an excised specimen. The author advocates histological examination in all cases of tumor of the bladder, prostate and uterus. Radiotherapy should not be used until after the cystitis is cured and then only if malignancy has been demonstrated by microscopic examination.

In treating carcinoma of the prostate, cervix and bladder, the condition of the rectum and the whole urinary system must be taken into consideration, and particularly the great sensitiveness of the bladder mucous membrane to irradiation.—*Audrey G. Morgan.*

Du Mesnil de Rochemont, René. Über die Röntgenbehandlung der Mediastinal- und Lungentumoren. (Roentgen treatment of tumors of the mediastinum and lungs.) *Strahlentherapie*, 1934, *50*, 290–296.

The material classified under the name of tumors of the mediastinum and lungs is so varied in nature that a statistical evaluation of it as a whole might well lead to mistaken conclusions. There are three very dissimilar groups of these tumors. The first cannot be influenced by radiotherapy at all, the second only to a moderate and the third, while the majority of them cannot be radically cured, yet can be reduced in size and the symptoms very favorably affected.

The first group that are entirely unsuited for roentgen therapy include lipomas, fibromas, chondromas, teratomas, cysts and of course all changes of the heart, pericardium and aorta. Histologically they are benign but from their localization in the closed thorax and in the immediate vicinity of the respiratory tract they may be dangerous to the patient. Differential diagnosis in this group is particularly difficult.

The second group which can be affected only to a limited extent includes bronchial carcinomata and metastases of carcinomata and sarcomata from other organs. The prognosis is rendered worse by the fact that these tumors show few symptoms for a long time and are hard to differentiate from other diseases. They are frequently not recognized until the patient's general condition is very much reduced and they are so extensive that a very large area must be irradiated, which involves severe injury of the blood and further depression of the patient's general condition. In such cases it is often better to give only a small dose to alleviate the patient's symptoms rather than a large one designed to really destroy the tumor. But treatment with small doses often helps the patient more than the morphine treatment usually used by the practicing physician. The author gives small doses of about 100 r every day or every other day and they often have a surprisingly good effect on the cough, dyspnea and pain, without any danger of roentgen sickness.

Among the 20 cases of lung tumor of this group which the author has treated in recent years, fully half have died in the first three months after treatment. In some cases larger doses were given, basing the amount on the reaction to the early doses. Some of the patients lived for a year, 4 of them for two years. This treatment particularly relieves the tormenting dyspnea from which these patients suffer.

The third group of tumors which do recede under roentgen treatment includes tumors of the mediastinal glands, the lymphomata of leukemias, lymphogranulomata and lymphosarcomata. The latter react the most rapidly, so rapidly that treatment must be begun very cautiously; otherwis the tumors may swell and cause suffocation from pressure or the body may be flooded with products of disintegration of the tumor, leading to general intoxication and roentgen cachexia. The tumor should be reduced very slowly and cautiously but finally a large dose may be given to cleanse the tumor bed. The author demonstrated a patient who had remained free of symptoms for nine years after such a treatment.

Mediastinal gland tumors can also generally be reduced, though not so quickly or with such small doses as lymphosarcomata. Lymphogranulomata react even more slowly. There is still a considerable difference of opinion as to the best technique for treating these tumors. Some authors proceed as for lymphosarcomata,

using only the dose necessary to relieve the symptoms. The result seems to depend more on the stage of the disease and the age of the patient than on the technique of irradiation. Young individuals generally react particularly well. The results should be followed up by screen control and a careful watch kept on the reactions.—*Audrey G. Morgan.*

KRUGLIKOWA, R. K. Zur Röntgentherapie des Skleroms der oberen Luftwege. (Roentgen therapy of scleroma of the upper respiratory tract.) *Strahlentherapie*, 1934, *50*, 333–344.

The author discusses the 172 cases of scleroma of the upper respiratory tract treated at the Roentgen-radium Institute of Kiev. In 1926, he reported 33 patients treated by his combined method, which consists of cauterization with carbon dioxide snow followed the next day by roentgen irradiation. They have now treated 172 cases, 47 of which withdrew after the first treatment, leaving a total of 125 fully treated. Of these, 31 were of the nose, 19 of the nose, nasopharynx and trachea, 36 of the nose and larynx, 36 of the larynx alone and 3 of the larynx and bronchi. Of the cases in the nose, 20 were cured, 4 considerably improved, 6 improved, 1 unchanged and 0 grew worse; the corresponding figures for the cases involving the nose, nasopharyngeal space and trachea were 4, 3, 9, 3 and 0; for the nose and the larynx 3, 6, 22, 4 and 1; for the larynx 1, 6, 21, 6, 2; all 3 of the cases of the larynx and bronchi were improved. It is of course easier to treat the cases which involve the nose alone as they are more accessible.

The cases treated since 1926 have given much better results than the ones treated before that time. Before 1926 they used 120 kv., filter 3 mm. aluminum, ½ skin erythema dose with intervals of six weeks; now they use 160 kv., filter 0.5 mm. copper and 1 mm. aluminum, ¼ to ⅓ skin erythema dose and an interval between the first two treatments of three to four weeks and later of two months.

This combined treatment is now the method of choice for scleroma of the upper respiratory tract. The combination of roentgen therapy and carbon dioxide snow gives the quickest and most effective results in scleroma of the nose. In other localizations, antimony preparations are used effectively as sensitizers and the roentgen therapy is combined with other methods such as tracheotomy, sounding and laryngofissure.—*Audrey G. Morgan.*

FREUND, LEOPOLD, and KNOFLACH, JOSEF G. Teleangiektasien und Strahlenbehandlung. (Telangiectases and radiotherapy.) *Strahlentherapie*, 1934, *50*, 326–332.

Too large doses of roentgen rays sometimes cause serious injury. The patient should be kept under observation and carefully examined before the beginning of a new series of treatments for telangiectases, atrophy or pigmentation.

Such changes may appear, however, from other causes, and it is important to differentiate them from those caused by roentgen rays. The author describes a case in a woman, aged fifty-eight, who was operated on for carcinoma of the breast and irradiated afterward. She was given three series with a total of 30 treatments in the course of four months, the total dosage being 2,400 r, with a filter of 3 mm. aluminum. Two months later telangiectases appeared around the scar. As it was only two months since the end of the treatment and the doses had not been excessive, it did not seem that these should be roentgen telangiectases. A review of the history showed that the patient had had similar telangiectases around the nipple before the operation.

Excision of a specimen from the telangiectatic area showed the picture of erysipelas carcinomatosum which spreads along the blood vessels. As the change was so extensive that it could not be radically removed, ten irradiations of 90 r each filtered through 3 mm. aluminum were given within a month. This at first caused quite an intense erythema and then the red spots began to fade. The patient is still under observation.

The prognosis in this form of carcinoma is very bad. None of the patients described heretofore have lived more than two years.

The special importance of this form of carcinoma lies in its differentiation from roentgen telangiectases.—*Audrey G. Morgan.*

CHAOUL, H. Weiterer Beitrag zur Röntgenbestrahlung des Karzinoms. (Further contribution to the roentgen treatment of carcinoma.) *Strahlentherapie*, 1934, *50*, 446–452.

The author discusses a new method of roentgen therapy which he has been practicing for about three years. Since its first description he has had further opportunity to study certain physical, technical and biological problems connected with it, and the observation time of

the cases treated is longer so he thinks a supplementary report is justified.

The action of roentgen rays may be approximated to that of radium by shortening the focus-skin distance and using a comparatively low tension. After many experiments he found that a focus-skin distance of 5 cm., 60 kv., and 0.2 mm. copper filtration were best for his method. This gives a rapid fall of energy from the skin to the deep tissues similar to that in radium irradiation. Shorter distances than 5 cm. may be used for very superficial tumors, or longer ones and harder rays for very deep ones, but it must be remembered that any change in physical conditions also involves a change in biological conditions.

As an illustration, he cites the case of a patient with an inoperable carcinoma of the breast. She was irradiated according to the conditions described above over a field of 16 sq. cm., a total dose of 7,000 r being given in twenty-three days. On a second field, where a greater depth effect seemed to be desirable the same dose, same size of field and same time distribution were used but with a tension of 180 kv., 10 cm. distance and 0.5 mm. copper. At the end of the treatment there was an exudative reaction of both fields which at first seemed to be of the same intensity in both. But while healing occurred in the first field after three weeks, in the second an ulcer necrosis developed which required months for healing. This shows strikingly that the biological effect of the two methods is quite different, and that with increasing depth effect the skin tolerance decreases.

The use of a short distance requires special tubes but this difficulty has been overcome and suitable tubes constructed. Small fields should be used with this method also, usually 10 to 15 sq. cm., never over 25 sq. cm.

The time factor is utilized by giving daily doses of 300–500 r. The doses are not diluted but as short irradiation times as possible used, with a dosage per minute of 100–150 r. Experiment has shown that this high concentration is well borne and that the decisive factor in skin tolerance is not the dilution of the dose but the time during which it is given. It was found that with a given dose the skin reaction was the same, no matter whether it was given continuously and diluted over a period of five hours or if it was concentrated with longer intervals, provided the total time of five hours was the same. The value of short irradiation lies not only in the saving of time, but under some conditions, as in the irradiation of tumors of the mouth, it is absolutely indispensable. The short time required for the treatments gives this method an advantage even over radium.

The size of the individual dose is determined by the size of the field; the smaller the field, the larger the dose that can be used. Total doses of 6,000 to 8,000 r are borne without any bad effect. They generally cause an exudative reaction that heals within two to three weeks. Doses even as high as 9,000 to 10,000 r may be given in ulcerated cases or cases in which the skin reaction is not intense. If the skin reaction is too intense, the dose should be lowered or the irradiation discontinued. The tolerance of the mucous membrane is even greater than that of the skin.

A repetition of the irradiation under the same conditions three to four weeks after the first series does no harm. This is not true of ordinary irradiation or irradiation by Coutard's method.

This method is indicated for cancers which are readily accessible to irradiation such as those of the skin, lips, mouth and uterus. The author's material does not include any genital carcinomata. Within three years he has treated 103 cases. Of these, 90 per cent are free of symptoms. This of course is of only relative value because of the short observation time but most of the cases were severe, infiltrating inoperable cancers or operative recurrences.

Efforts are being made to extend the usefulness of the method and Chaoul describes a case of carcinoma of the rectum which was exposed surgically and then irradiated, which indicates that such a procedure may increase the field of indications for the method.—*Audrey G. Morgan.*

Schreus, H. Th. Weitere Ergebnisse der Röntgenbehandlung des Heufiebers. (Further results of the roentgen treatment of hay fever.) *Strahlentherapie*, 1934, *50*, 462–467.

The author has previously reported results in the roentgen treatment of hay fever which show that irradiation has a specific desensitizing effect. The desensitizing action, however, occurs in only about half the cases and is not always permanent. He now reports 48 more cases treated from 1930 to 1933. He sent out a questionnaire to find the late results but 13 of these patients did not answer. This leaves 35, of whom 6 are cured up to the present time;

that is, their condition is satisfactory to them and they are free of symptoms, 2 after four years, 3 after two years and 1 after one year. There was good to very good improvement in 9 cases and moderate improvement in 7; no result in 13.

He has so far given two or three irradiations, the first one of 20 per cent S.E.D., the second and third of 15 per cent S.E.D., size of fields on the nose 6×8 cm., 0.5 mm. copper filter. He thinks in the future it will be preferable to give irradiations of 15 to 20 per cent S.E.D. every ten to fourteen days throughout the hay fever period to keep up the desensitization. The effect seems to be more permanent the sooner it begins after the beginning of treatment.

He thinks that probably the treatment of choice is roentgen irradiation combined with injections of desensitizing substances.—*Audrey G. Morgan.*

BECKER, SIEGFRIED. Die Wirkung von Radiumemanationskuren auf die Alkalireserve des Blutes. (The effect of radium emanation treatments on the alkali reserve of the blood.) *Strahlentherapie*, 1934, *50*, 468–470.

The author studied the effect of radium emanations on the alkali reserve of the blood; the treatment was given by mouth in 3 cases, by enema in 2, in the form of inhalation in 2.

The alkali reserve was decidedly decreased by the radium emanations in 13 cases, in 4 cases by 10 volumes per cent and in 9 cases by 5–8 volumes per cent; 1 case was not affected and in 1 there was a slight rise. The hypocapnia persisted for several weeks, on an average four weeks; in most cases it returned to normal after that. No relationship could be demonstrated between the subjective symptoms and the degree of the hypocapnia.

Previous experiments with ultraviolet and roentgen rays have not shown such a pronounced and long-continued hypocapnia.

This movement of the alkali reserve does not necessarily show a true reaction in the blood, as the hypocapnia can be compensated by regulation of the respiratory center (increased CO output from hyperventilation). But the change in the alkali reserve in connection with the changes in the white blood picture and the blood sedimentation reaction shows great similarity to what occurs in protein body therapy. The low point of alkali reserve coincides with the high point of clinical manifestations. —*Audrey G. Morgan.*

NEUGEBAUER, KURT, and STAUNIG, KONRAD. Über Röntgentherapie der Paradentitis. (Roentgen therapy of paradentitis.) *Strahlentherapie*, 1934, *50*, 453–461.

Six cases of paradentitis treated with roentgen irradiation are described and illustrated with roentgenograms. For the first few days, there was in many cases an increase of the symptoms; the gums bled more readily and profusely, there was often a feeling of tension and heat in the jaw that in some cases increased to actual pain, which however did not last more than twenty-four hours. One patient complained that his taste sensation was greatly decreased for two days; several complained of temporary dryness of the mouth. There were no changes of the skin.

After six to eight weeks the gums began to retract and showed a normal rose-colored appearance. The bad odor from the mouth disappeared; the gums were applied closely to the teeth and in spite of the retraction the necks of the teeth were not sensitive to temperature changes and the patients had a healthy feeling in their mouths. None of the patients showed a flaring up of a periapical process or any other complication. There was no recurrence during the observation time of three to seven months.

Even during the first few days there was a remarkable increase in the firmness of the teeth. Often teeth that had been very loose became normal. The treatment never increased the loosening of the teeth.

There was not much change in the roentgen picture. In no case was there any further progress of the atrophy and in some cases the bone showed greater calcium density after the treatment and the structure of the spongiosa was richer in contrast. Complete cure of the paradentitic process in the bone was seen in only one case; probably this can take place only after the inflammation in the soft parts has been cured.

It might be supposed that the retraction of the gums would have a bad cosmetic effect but the patients never complained of it. Any treatment of an advanced paradentitic process necessarily causes some retraction of the gums. One advantage of the roentgen treatment is that the sensitiveness of the necks of the teeth to various irritations is overcome.—*Audrey G. Morgan.*

HEDFELD, A. Zum Problem der Erkrankung "der sogenannten malignen Tumoren" und

ihre strahlentherapeutische Beeinflussung. (The problem of the disease "of so-called malignant tumors" and the influence of radiotherapy on it.) *Strahlentherapie*, 1934, *50*, 312–325.

The conception that cancer is a local disease has gradually been given up in recent years in favor of the belief that it is a general disease. This general disease is a disturbance of metabolism of the most radical character, involving the endocrine and reticulo-endothelial systems. Therefore an attack on the local manifestation, the tumor, does not cure the general disease. Successful treatment must be based on increase of the defensive forces of the body by forced nutrition and by organotherapy such as that used by Fichera. In the attack on the manifest tumor, radical operations must be given up and a radiotherapy given which pays strict attention to the rule that the irradiation must be confined as much as possible to the tumor itself. For this reason, the author rejects protracted fractional irradiation and other methods carried out schematically. In radiotherapy, the most careful attention must be given to the reaction of the general organism as an indicator of the defensive forces of the body.

The method which the author has been using successfully for the past four years in the treatment of carcinoma of the breast is described. He rejects the method of radical removal of the breast and the glands. Even in so-called operable tumors of the breast, he irradiates the tumor and the regional lymph glands, using Holfelder's tangential field choosing method. After the retrogression of the tumor during the most favorable stage, the rest of the breast is removed with a high frequency incision and the least possible wound, and as soon as possible prophylactic after-irradiation is given. Special emphasis is placed on forced nutrition and the patients are kept under observation every three months for at least two years. If there was swelling of the axillary glands, the breast tumor is not removed until the swelling of the glands has receded completely. For the past three months he has also been using Fichera's organotherapy.—*Audrey G. Morgan.*

Baensch, W. Über die Anzeigestellung der Strahlenbehandlung der Sarkome und Knochengeschwülste. (Indications in the radiotherapy of sarcomas and bone tumors.) *Strahlentherapie*, 1934, *50*, 278–289.

The author reviews the question of the radiotherapy of sarcoma and comes to the conclusion that the field of sarcoma treatment is not a particularly hopeful one whether treatment is surgical or radiotherapeutic. It is much more difficult to diagnose sarcoma than carcinoma, sometimes quite impossible. Moreover, the prospects for cure of sarcoma are much poorer than those for carcinoma because of the early and extensive metastasis.

The more immature the cells of a sarcoma, the greater its radiosensitiveness. But this advantage is counteracted by the particularly early metastasis of tumors with immature cells. Bone sarcomas with the exception of Ewing's tumor and epulis should be operated on as early and as radically as possible, also chondrosarcomata and sarcomata of the fascia. Melanosarcomata should also be operated on as early as possible and the electrosurgical excision carried far into normal tissue. After-irradiation with radium should be given. Lymphosarcomata should be treated only with irradiation, as their localization generally makes surgical removal impossible. If these general directions are followed it will be possible to keep a certain percentage of patients with these forms of sarcoma alive beyond the five-year limit, while formerly they would have died in a very short time.—*Audrey G. Morgan.*

Stewart-Harrison, R. Über maligne Erkrankungen des Kehlkopfes und des Rachens. (Malignant disease of the larynx and pharynx.) *Strahlentherapie*, 1934, *50*, 91–126.

The author reports work at the Schinz Clinic in Zürich. From the spring of 1929 to the end of 1931, 144 cases were treated. A stabilovolt transformer was used and Müller tubes, with a tension of at least 170 kv. and a current of 3 ma.; filter 1 mm. aluminum and 13 mm. copper; the resultant half-value layer was equivalent to 1.35 mm. copper. The tube-skin distance varied from 65 to 75 cm.; it was adjusted to a radiation intensity of 2.5 r per minute, measured in air (r/1 per minute); with a focus skin distance of 50 cm. this gave 3.6 r/1 per minute. The fields were so chosen that they included the primary tumor and the regional metastases. In all tumors, two lateral fields were irradiated and in tumors of the hypopharynx and larynx often three. If there were no contraindications the patients were irradiated daily on the side of the lesion. On five days in the week one other field was irradiated. On Sunday they were allowed to rest. Generally 180 r/1 was given at

a treatment. Ordinarily the treatment required three weeks.

Typical cases are described and a table given showing the number of cases in the different regions and the number of local recoveries with freedom from symptoms after periods of from nine months to three and a half years. In the epipharynx there were 4 tumors, 3 recoveries, in the tonsil 24 tumors, 8 recoveries, at the base of the tongue 16 and 7, of the vallecula 11 and 3, of the mesopharynx 4 and 2, of the epiglottis 4 and 0, of the aryepiglottidean fold 7 and 3, of the arytenoid cartilage 4 and 2, of the pyriform sinus 44 and 7, of the postcricoid 2 and 0, extensive tumors of the hypopharynx 9 and 0, of the larynx 15 and 6.

The author concludes that the protracted-fractional method of irradiation is the method of choice in tumors of the epipharynx, mesopharynx and hypopharynx and is to be considered in all tumors of the larynx; in many of these it is the treatment of choice.—*Audrey G. Morgan.*

FUGE, KURT. Untersuchungen über den Einfluss therapeutischer Radium- und Röntgenbestrahlungen auf das Blutcholesterin und die Leber. (Studies of the effect of therapeutic radium and roentgen irradiation on blood cholesterin and the liver.) *Strahlentherapie*, 1934, *50*, 157–166.

The author made blood examinations of 31 women at the University Gynecological Clinic of Halle before and after irradiation in order to determine the blood cholesterin content of women with carcinoma and the changes brought about in it by roentgen and radium irradiation.

He found that the blood cholesterin content of the 31 carcinomatous women was not increased above that of normal women. Neither radium or roentgen irradiation had any uniform effect on the blood cholesterin content, in the direction of either increase or decrease. In the majority of cases, there was a decrease of total cholesterin after the irradiation but in some cases there were considerable increases.

In all the cases, not only total cholesterin but also free cholesterin was determined and the percentage of ester cholesterin to total cholesterin determined. According to some authors, constancy of this quotient is an indication of normal liver function. In the above investigations there was so little change in the quotient before and after irradiation that there is no evidence as to damage of the liver parenchyma by the irradiation.

The method of Mühlbock and Kaufmann was used to determine the cholesterin. Attention is called to the defects of the colorimetric methods.—*Audrey G. Morgan.*

SCHINZ, H. R., and ZUPPINGER, A. Bericht über die Züricher Erfahrungen mit protrahierter-fraktionierter Röntgenbestrahlung der Jahre 1929–1932 bei Tumoren der oberen Luft- und Speisewege. (Report of experience at Zürich with protracted-fractional roentgen irradiation of tumors of the upper respiratory and digestive tracts from 1929 to 1932.) *Strahlentherapie*, 1934, *50*, 237–277.

The authors report the results of protracted-fractional irradiation in cases that have been under observation for more than two years. From April, 1929, to April, 1932, 184 cases of malignant tumors of the upper respiratory and digestive tracts were observed at the Roentgen Institute of the University of Zürich, including 8 of tumors of the internal nose and ethmoid cells, 6 of the maxillary sinus, 11 of the mouth, 66 of the mesopharynx, 72 of the hypopharynx and 15 of the larynx. The cases of tumor of the mouth in which radium puncture was used were not counted.

The material was very poor. Only 23 of the 184 cases were in the operable stage, and only 17 of these did not show any clinical metastases. Thirteen cases, or 7 per cent, already had distant metastases on the first examination, 23, or 12 per cent, had bilateral metastases. Among the 184 cases, only 135 could be given complete treatment; as a rule in the other cases the general condition was such that only palliative irradiation was indicated, or such that the treatment had to be stopped.

After two years 25.9 per cent of the cases that were given complete treatment were still alive and free of symptoms, or 19 per cent of the total number of cases. Twenty-two per cent of the thoroughly treated cases, or 16.3 per cent of all the cases, are alive and free of symptoms between two and five years after treatment. The absolute freedom from symptoms for three years is 18 per cent, the relative figure 23.8 per cent. Taking into consideration only the pharynx cases, the absolute three-year healing is 16.9 per cent, the relative 21.8 per cent.

In tumors of the inside of the nose and accessory sinuses, including the maxillary sinus, freedom from symptoms was attained by irradi-

ation alone only in very radiosensitive tumors. As a rule, combined surgery and irradiation was necessary in these cases. Tumors of the mouth as a rule are more resistant to protracted-fractional roentgen irradiation than tumors of the pharynx. They contract but as a rule do not disappear entirely. The tumors of the epipharynx all proved highly sensitive. In all of these in which the treatment was carried through, freedom from local symptoms was attained.

In tumors of the mesopharynx results were very good for the sarcomas. As almost all the cases were cured locally, the authors give preference over all other methods of treatment to protracted-fractional irradiation in sarcomas of the mesopharynx. In carcinomas of the tonsil there was always contraction and in a considerable number primary freedom from symptoms. As a recurrent tumor often occurs or a residual tumor remains at the angle between the pillar of the fauces and the tongue, a supplementary treatment in the form of radium puncture or radium molds or electrocoagulation is necessary. The prognosis of tumors at the angle between the pillar and the tongue is the most unfavorable, evidently as a result of the very deep primary growth. Tumors of the vallecula are, as a rule, sensitive; recurrences seem to originate particularly from the cartilage.

In tumors of the hypopharynx, protracted-fractional irradiation is at present to be considered the treatment of choice. The prognosis is best in tumors of the upper circumference of the larynx, worst in tumors of the pyriform sinus, particularly in large tumors, because the cartilage is already involved and it is very hard to demonstrate this clinically.

The majority of tumors inside the larynx are also sensitive. Cases that are not adapted for irradiation can be excluded by histological and clinical examination. No late injuries were observed in the period of observation, though a few early injuries from overdosage were seen.

The results can probably be improved by adapting the dosage to the general condition in the individual case.—*Audrey G. Morgan.*

Maier, Emil. Lymphoepitheliale Tumoren. (Lympho-epithelial tumors.) *Strahlentherapie*, 1934, *50*, 611–622.

Since it has been found that certain types of tumors can be cured by systematic roentgen irradiation, increasing efforts have been made to classify tumors from the practical clinical point of view. One of the groups of tumors that have been separated out from carcinoma and sarcoma is that of the lympho-epithelial tumors of the mouth and pharynx. They are localized in the tonsils and throughout the pharynx, at the base of the tongue, in the larynx and even in the thymus. They are of reticulate epithelial structure intermixed with lymphocytes. The histological diagnosis, however, is quite difficult.

Five cases are described, illustrating the difficulties of histological diagnosis and showing the effects of roentgen treatment. In only 2 of them could the diagnosis be made at once from the histological examination of a biopsy. In the others, the clinical course had to be taken in conjunction with the histological picture. If the examiner finds an admixture of lymphoid cells in an epithelial tumor, particularly if it is ulcerated, he is apt to make a diagnosis of carcinoma simplex with inflammatory infiltration. On the other hand, the lymphoid cells may be so numerous that a diagnosis of lymphosarcoma is suggested. There is to a certain extent a subjective element in the diagnosis of lympho-epithelial tumor.

Clinically the patient's good general condition is in contrast with the development of the tumor. The color may vary from an almost normal appearance to a bluish-red appearance caused by such an abundance of vessels that the tumor may be mistaken for a hemangioma. The form of the tumor is rather characteristic. It is made up of irregularly rounded nodules, relatively firm in consistency. There is also an infiltrating form in which the ulcer is generally superficial. The early development of lymph gland metastases is to a certain extent pathognomonic. The glands do not become confluent as in tuberculous lymphoma, but remain separated as individual glands, which feel harder than the surrounding infiltrate. Distant metastases are also produced, particularly in the abdominal lymph glands, and sometimes in the bones, particularly the vertebrae.

The patients generally come for treatment free of pain but with an unpleasant feeling from the presence of the tumor or the lymph gland metastases. Generally the tumors grow slowly but produce early lymph gland metastases. Local metastasis has generally occurred when the patient comes for treatment. If an exploratory excision is made it should be made with the cautery, or at least the surface, made with a sharp knife, should be cauterized; otherwise the tumor may be disseminated.

The treatment of choice is irradiation. The author uses distant radium treatment and if necessary a local application of radium. He did not find electrocoagulation necessary in any case. The distant radium irradiation covers a large surface and there seems to be a certain distant action which brings about complete freedom from symptoms. Most authors advocate protracted roentgen irradiation, combined if necessary with local application of radium or electrocoagulation. The author gives a warning against short intense roentgen therapy and surgery. Patients can be freed of symptoms by intense brief roentgen therapy but distant metastases are frequent.

The prognosis is considered good in the large roentgen institutes. Berven of Stockholm reported 55 per cent cures; Regaud and Coutard reported 45 per cent cures. Some authors have reported poor results, probably due at least in part to wrong diagnoses. But it must be admitted that there are unknown factors that play a part in the treatment.—*Audrey G. Morgan.*

ALTSCHUL, WALTER. Bei welchen Bestrahlungen spielt der Sympathikus eine Rolle? (In what irradiations does the sympathetic play a part?) *Strahlentherapie*, 1934, *50*, 669–676.

Dermatologists introduced the so-called spinal cord irradiation for the treatment of extensive dermatoses. But it was found later that the results were not caused by the action of the irradiation on the spinal cord but by its action on the sympathetic nervous system. And the segmental irradiation in beginning sclerotic or diabetic endarteritis obliterans with spasms or disturbances of sensation is really fundamentally an irradiation of the sympathetic. In addition to these treatments, that are direct irradiations of the sympathetic system, it is probable that there is a sympathetic factor in all irradiations of endocrine glands, in view of the close relationship between these glands and the sympathetic system. There are also a number of irradiations which are considered as irradiations of organs but in which the sympathetic system certainly plays a part and in some of them doubtless the decisive part. These include irradiation for ulcer of the stomach and duodenum, in which there is an action on the celiac ganglion and an increase of reticulo-endothelial function through the irradiation of the spleen; also irradiation in bronchial asthma, in which there is an action on the pulmonary plexus and an increase of reticulo-endothelial function through irradiation of the spleen. These forms of irradiation have given excellent permanent results in the two above-named diseases, while irradiation of the splanchnic has given noteworthy but only temporary results in the treatment of genuine epilepsy.—*Audrey G. Morgan.*

MIKULICZ-RADECKI, F. v. Über Misserfolge der Röntgenkastration und -sterilisierung wegen Lungentuberkulose. (Failures of roentgen castration and sterilization for pulmonary tuberculosis.) *Strahlentherapie*, 1934, *50*, 658–668.

Histories are given of 16 cases in which roentgen irradiation was used to sterilize women temporarily on account of pulmonary tuberculosis. A stabilovolt apparatus was used, fields 6×8 cm., focus-skin distance 30 cm., 0.5 mm. copper and 3 mm. aluminum filter, 185 kv., 3 ma. The dosage varied from 270 to 329 r. This is the dosage that has been used by the Königsberg Clinic for the castration of elderly women (climacteric hemorrhages, myomas). This dosage was, as a rule, sufficient for the latter purpose, though even there recurrences were observed in some cases.

But in 3 of the cases described above undesirable pregnancies occurred and artificial abortion had to be performed. That is failure in 20 per cent of the cases. These women were all less than thirty years old. It may be argued that for patients of this age a permanent amenorrhea was not to be expected from that dosage and that in 2 of these cases a temporary amenorrhea was brought about. This may be true from the standpoint of roentgen technology, but from the standpoint of practical medicine, which is the only one to be considered in these cases, it means a failure of the method: sterilization was not attained for the duration of the disease.

There are two other reasons for rejecting roentgen sterilization. The first is that there is danger of the irradiation injuring the children if pregnancy does take place. The second is that the irradiation may lead to later disease of the ovary. In one of these cases the picture of glandular hyperplasia of the mucous membrane of the uterus developed after some years. The cause of this condition is defective maturation of the follicles. It seems quite probable that this disturbance of ovarian function was caused by the irradiation. If sterilization is in-

dicated it should be performed surgically and not by roentgen irradiation.—*Audrey G. Morgan.*

Dyes, Otto. Die Behandlung der Aktinomykosis. (The treatment of actinomycosis.) *Strahlentherapie*, 1934, *50*, 641–657.

The author advocates the use of a single large dosage of radiation (100 per cent s.e.d.) in the treatment of actinomycosis. He discusses three groups of cases treated in the Roentgen Section of the Surgical University Clinic of Würzburg, which confirm the value of this method. The cases were all ones of actinomycosis of the neck and face. The first group was given 1 s.e.d. over the focus, either at one sitting or in the course of six days. In the second group a dose of 40 to 60 per cent s.e.d. was given in several sittings with an interval of some weeks between them and in the third group less than 40 per cent s.e.d. was given, generally 25 per cent. The results argue in favor of the first method. The irradiation should be given homogeneously by Holfelder's method. Hard rays were used: 180 kv., 0.5 mm. copper and 3.0 mm. aluminum filter with a half-value layer of 1.05 mm. copper with a stabilovolt apparatus.

Certainly more is accomplished by this method than by the former method of extirpation of the whole focus. Surgical treatment often results in the development of fistulas and even if surgery is used, after-irradiation should be given. The time required for treatment is very considerably shortened by the use of irradiation and the use of the single large dose results in a greater saving of time than any other method. Moreover, the use of irradiation in cervicofacial actinomycosis has the great advantage of not leaving any scar.—*Audrey G. Morgan.*

Haenisch, F. Röntgentherapie bei Spondylarthritis ankylopoetica. (Roentgen treatment in spondylarthritis ankylopoietica.) *Strahlentherapie*, 1934, *50*, 623–640.

The author describes and illustrates with roentgenograms 13 cases of ankylopoietic spondylarthritis which he treated with roentgen irradiation. They were all fairly severe cases. The technique was as follows: 3 to 4 fields along the spinal column, and in some cases 1 to 2 fields on the right and left of the sacroiliac synchondrosis. Size of fields 10×12 cm. to 10×15 cm.; 130 r five times to each field, with a filter of 0.5 mm. copper and 1 mm. aluminum and a half-value layer of 0.9 mm. copper; distance 30 cm., intensity 28–35 r/min.; intervals five to ten days. The series may be repeated after six months. The treatment must be individualized in each case, depending on the severity of the case and the reaction to the irradiation.

In 3 of the cases reported it is too soon to pass judgment on the results. In the other 10 cases the subjective symptoms have been greatly improved and in some cases overcome entirely. All of these 10 patients are very well satisfied with their condition. In 2 very severe cases in young people the patients were able to resume their work and one of them to resume his favorite sport of bicycling. Both these patients were under treatment for more than four years. Most of these patients had been treated in other ways without any effect.

The cases are too few and the observation time of three to four years too short for definite judgment to be passed on the effect of the treatment on the process of ankylosis. The author is inclined to think that its progress was not stopped in spite of the improvement in the general condition and the cessation of pain. It is probable, however, that its course was retarded and the length of life increased. At any rate, he thinks roentgen treatment is worth trying in this disease.—*Audrey G. Morgan.*

Baumann-Schenker, Rudolf. Über das Rundzellensarkom. (Round cell sarcoma.) *Strahlentherapie*, 1934, *51*, 201–236.

This article deals with 60 cases of a group of tumors known as round cell sarcomas in the broadest sense of the word. They are divided into three groups: lymphosarcoma, reticulum cell sarcoma and round cell sarcoma in the narrower sense of the word. The histological and clinical characteristics of these three groups are discussed.

There were 31 cases of lymphosarcoma divided into two groups, localized forms and generalized forms. The localized forms included 10 cases of primary tumor of the nasopharyngeal space, 6 cases of solitary mediastinal tumors, 2 cases of solitary tumors in closely circumscribed lymph gland regions and 1 case of solitary abdominal tumor. The generalized forms included 3 cases of generalized superficial lymph gland regions, 1 case of sarcoma of the skin, 1 of tumors, chiefly abdomi-

nal, 6 of superficial and deep lymph node regions, and 1 of the intestine.

Freedom from symptoms for three years, one year and eight months was attained in 30 per cent of the tumors of the nasopharyngeal space. Freedom of symptoms up to the present date was also attained in 30 per cent of the other localized forms. In the generalized forms, the results were for the most part only palliative. In some of the cases, the treatment had no effect at all.

Six cases of reticulum cell sarcoma are described, all of them except one in the nasopharyngeal space. Two of the patients are free of symptoms four and two and a half years after protracted-fractional irradiation; treatment was recently begun in one.

There were 23 cases of round cell sarcoma in the narrower sense, also divided into circumscribed and generalized forms. Twelve of the localized forms were primary tumors in the nasopharyngeal space, 1 in the stomach, 1 a localized tumor of the mesentery, 1 a localized tumor of the right side of the neck. Four of the generalized ones were tumors of the soft parts, 1 of superficial lymph node regions and 3 of both superficial and deep lymph gland regions. Treatment of the tumors of the nasopharynx resulted in freedom from symptoms for six years, one year and five months and one year and three months in 33 per cent of the cases. Among the other localized cases, 1 is free of symptoms after four months. Among the generalized forms 37.5 per cent showed palliative results.

The author concludes that the best prospects of success are offered in radiosensitive tumors of the nasopharynx by protracted-fractional roentgen treatment. It brings about complete sterilization of the tumor region and therefore prevents propagation. It has the advantage over a single large dose in that it does not cause flooding of the body with large amounts of toxins from breaking down of the tumor. It also avoids the danger of sudden swelling of the tumor. A third advantage is that it can be repeated if the dose given at first does not reach the limit of skin tolerance. It is rarely necessary to raise the dose to the limit of skin tolerance in the first series.

The results show the superiority of the protracted-fractional method over all other methods of roentgen or radium treatment used heretofore. A calculation of the average prolongation of life by this method and the other methods also shows its superiority in this respect. However, all of the cases in which this method was used were treated in 1930 or later and a longer observation time is required to make the figures absolutely comparable.

Statistics from other authors are cited which also show the superiority of the protracted-fractional technique. The author believes that surgical treatment alone of these tumors is dangerous and insufficient.—*Audrey G. Morgan.*

STEWART-HARRISON, R. Das Anwendungsgebiet der Radiumtherapie. (The field of usefulness of radium therapy.) *Strahlentherapie*, 1934, *51*, 57–80.

The author reviews the work done at the Roentgen Institute of the University of Zürich from 1929 to 1933, discussing the methods of radium treatment used and the results attained in different forms and localizations of tumors. He concludes that the best field for the use of radium is in the treatment of cancer of the skin, lips, tongue and uterus. It can also be used successfully in the treatment of recurrences and residual tumors, particularly in the mouth. In this field it is generally used as a supplementary treatment after roentgen irradiation, chiefly at the Zürich Institute after protracted-fractional roentgen treatment. Under these circumstances, ulcers have sometimes been produced, especially if there was any injury or infection. Such ulcers were seen particularly after the method of using radium needles. The treatment of these ulcers requires a great deal of time and the ulcers themselves cause quite severe symptoms, but the prognosis is not absolutely bad. The average time required for cure is a year or more. The pain can be alleviated by short-wave diathermia. It is also possible that this heat treatment shortens the time required for cure.

The results of this supplementary radium treatment are not extraordinary and yet in several cases alleviation of symptoms was brought about for some time.—*Audrey G. Morgan.*

KUKOWKA, A. Kleinfeldröntgentherapie tiefliegender Tumoren. (Small-field roentgen therapy of deep-seated tumors.) *Strahlentherapie*, 1934, *51*, 312–318.

The author recommends a small-field technique which he has worked out in the treatment of malignant tumors. He irradiates ten or in

some cases more square or round fields with a surface of 4 sq. cm. each. Each field is irradiated with 600 r daily, 180–200 kv., 0.5 mm. copper filter, 3–4 ma., 23–50 cm. focus-skin distance. An effort is made to get as high as possible an effective dose. If the tumor is 10 cm. deep then by the above method, with 23 cm. focus-skin distance it is given an irradiation of 300 r, or 50 per cent of a skin erythema dose. With ten fields this gives a total irradiation of 3,000 r. One field is irradiated each day, so the treatment lasts ten days. If necessary the series is repeated in three to five weeks.

As the dosage of 300 r proved insufficient in some cases, he irradiated two fields a day with 300 r each. In this way the tumor at 10 cm. depth received 2×150 or 300 r a day. Each individual field was irradiated 4 times in the course of the series with 300 r, so that the total amount per field was 1,200 r. With ten fields the irradiation lasted twenty days and the amount of irradiation applied to the tumor at 10 cm. depth was 6,000 r. An effort was made to apply 4,000 to 8,000 r to the tumor. In many cases, smaller amounts proved sufficient.

The author has used this method on 63 cases since December, 1932. Brief descriptions of the cases are given. Among them 19 showed advanced cachexia and extensive metastases and appeared to be absolutely hopeless; 15 were operable but refused operation; in the rest operation was impossible for various reasons.

The author does not attempt to evaluate the material statistically as the number of cases is too small and the observation time too short. He is convinced, however, that this small-field method is superior to the usual methods for deep-seated tumors. All the patients bore the ambulant treatment well without any injurious by-effects. The effect on the tumors was satisfactory, considerably better than that of the usual roentgen methods and in some cases approximating the effects of radium. The method is more economical than the Regaud-Coutard method.—*Audrey G. Morgan.*

Nahmmacher, F. Die Chemotherapie als erfolgsreichstes Unterstützungsmittel der Strahlenbehandlung bei bösartigen Erkrankungen. (Chemotherapy as an effective supplementary agent in the radiotherapy of cancer.) *Strahlentherapie*, 1934, *51*, 305–308.

The use of certain chemical agents sensitizes tumor tissue so that the tumors become more sensitive to the action of irradiation. The author recommends a preparation for this purpose called Preparation RIII made by the Klopfer chemical works in Dresden. It is a combination of lithium, magnesium, hydratopectin and iodine put up in gelodurat capsules. The iodine stimulates tissue respiration and is supported in this action by the lithium and magnesium. The capsules are given 1 to 3 a day before, during and after the radiotherapy, a total of 720 capsules being given. He has had very good results with this preparation in many hundreds of cases.

Another supplement to the ordinary roentgen treatment is stimulant irradiations of the blood-forming organs, which he has used for the past six months in all cases of malignant disease, with constant control of the blood pictures. The chemotherapy and the stimulating irradiations of the blood-forming organs stimulate all the forces of the body in the struggle against cancer. Stimulant irradiation of the liver, which is the glycogen depositary of the body, mobilizes the glycogen which is given off to the body; this is necessary because of the increased glycolysis in malignant disease. It also brings about an increase of the liver function of glycogen storage.

The RIII capsules are not toxic and do not cause iodism.—*Audrey G. Morgan.*

MISCELLANEOUS

Grauer, Josef. Die Änderung der biologischen Wirksamkeit von Membranen unter dem Einfluss von Röntgenstrahlen. (The change of biological effectiveness of membranes under the influence of roentgen rays.) *Strahlentherapie*, 1934, *49*, 118–131.

In No. 40 of *Strahlentherapie* Saxe reported a study of the changes brought about in the permeability of membranes by irradiation with roentgen rays. He reported that the rapidity of diffusion through an unirradiated membrane is at first greater and then falls gradually, while through an irradiated membrane the values are at first low and then gradually reach higher levels. He also says that the rapidity of diffusion depends on the dosage of irradiation used, the difference from the non-irradiated membrane being greater the larger the dosage used.

The author doubted the accuracy of these results and therefore tested them, using pigs' bladders as membranes. The details of his experiments are described and curves given showing the results. He found that roentgen irradia-

tion did not affect the permeability of the membranes but that the curves were the same for irradiated and non-irradiated membranes. This remained true no matter what the dosage. —*Audrey G. Morgan.*

HERČÍK, F. Temperatur und biologische Wirkung der α-Strahlen. (Temperature and the biological action of alpha rays.) *Strahlentherapie*, 1934, *49*, 703–706.

In a recent work, the author called attention to the fact that the biological action of alpha rays may not be due so much to their capacity for ionization as to the action of temperature. In this article he describes experiments made to determine the effect of temperature. Cultures of bacteria were subjected to the action of alpha rays at different temperatures, 2.5°, 3.5°, 10°, 23°, 26°, 35°, and 36° C. The details of the experiments are described. The results of the experiments are shown graphically. They show that there was no difference in the curves of injury to the bacteria by the rays at the different temperatures. Therefore the mechanism of action of alpha rays is based on processes which are independent of temperature.—*Audrey G. Morgan.*

OBERHOLZER, J. L'arthro-pneumoradiographie (méthode de Bircher). (Arthropneumoroentgenography; Bircher's method.) *J. de radiol. et d'électrol.*, Jan., 1936, *20*, 18–23.

Bircher, in attempting to utilize the advantages of two types (positive and negative) of contrast media, has the merit of having introduced the method for roentgenographic study of joint spaces which now bears his name. He uses perabrodil (2 c.c.) as the positive and oxygen as the negative contrast. The former is deposited in thin layers on the wall of the capsule, on the menisci, ligaments and articular surfaces, whereas the latter outlines the entire articular space.

The author, in this article, describes in detail the technique of procedure, the pneumoroentgenographic image of the knee, shoulder and elbow in the normal as well as in cases of anatomic variations, lesions of the cartilages and ligaments, foreign bodies, etc., and arrives at the following conclusions: (1) Pneumoroentgenography of the articulations according to Bircher represents a method which, when carried out carefully and with an adequate technique, proves to be without danger. (2) In the knee joint, it permits the diagnosis of meniscal lesions, gives information on the condition of the ligaments, articular capsule and its various cul-de-sacs and especially on the cellular adipose tissue of Hoffa; finally it helps in the diagnosis of osteochondritis and the localization of intra-articular foreign bodies. (3) In the shoulder and elbow joints, it permits a precise estimation of the habitual luxation of the shoulder, the diagnosis of capsular alterations and of intra-articular foreign bodies.

The article is illustrated with some very unusual roentgenograms.—*T. Leucutia.*

PEREIRA, SOUSA, and DUPERTUIS, M. Recherches expérimentales sur la pathogénie des exostoses ostéogéniques à l'aide de greffes de cartilage de conjugaison. (Experimental researches on the pathogenesis of osteogenic exostoses with the aid of grafts of cartilage of conjugation.) *Presse méd.*, Jan. 25, 1936, *44*, 162–166.

The authors performed a series of experiments in young rabbits by grafting pieces of cartilage taken from the epiphyseal line of the humerus into the diaphyses of the same bone. The following conclusions are reached: (1) The autografting of live cartilage of conjugation on the compact tissue of the diaphysis (following removal of the periosteum) may determine the development of an osteogenic exostosis resembling entirely that observed in the human. (2) Autografting is not always successful, exostosis having developed in only 3 cases out of 9. The non-taking must be attributed to the lack of immediate contact of the graft with the osseous tissues of the diaphysis. (3) Autografting always fails to take whenever the cartilage is preliminarily fixed in 95 per cent alcohol. (4) In the experimentally obtained exostoses the orientation given to the graft cartilage fails to influence the development of the exostoses. (5) A comparison of the structure and evolution of the experimental exostosis with a single osteogenic exostosis observed in the human seems to confirm the theory of Leriche and Policard concerning the pathogenesis of osteogenic exostosis.—*T. Leucutia.*

DAHL, BJARNE. Die Gefässreaktion in der Schwimmhaut des Frosches—Rana temporaria—nach Röntgenbestrahlung. (The vessel reaction in the web of the frog—*Rana temporaria*—after roentgen irradiation.) *Acta radiol.*, 1936, *17*, 275–283.

The author irradiated the webs of the feet of 16 frogs with doses of from 2,000 to 4,000 r. Five of the animals died within the first few days while 11 of them lived for from ten to ninety days after the irradiation. He did this in order to study the mechanism of the action of the rays on the blood vessels, which is not very well understood. He found that the roentgen reaction in frogs is essentially the same as that in rats and man, though much slower, as would be expected in cold-blooded animals. He made control tests with mustard oil and found that the different degrees of the roentgen reaction are very similar to the degrees of the mustard oil reaction. Both the roentgen rays and the mustard oil bring about circulatory disturbances probably due to the development of edema and leading in both cases to necrosis of tissue.—*Audrey G. Morgan.*

Sievert, Rolf M. Two methods of roentgen microphotography. *Acta radiol.*, 1936, *17*, 299–309.

The author gives a short preliminary report of two methods of taking roentgen photomicrographs for comparison with ordinary photomicrographs. By using very soft roentgen rays it is possible because of selective absorption to show agglomerations of different cells in microscopic sections, large cells, etc. The first method permits of magnifications of 100 to 200 times, the second of 200 to 250 times.

In the first method, the object is placed either on the back of a photographic film or on a thin aluminum foil or other suitable thin material. The latter, in its turn, is placed directly on the sensitive layer and exposed at a long distance to soft roentgen rays from a roentgen tube with a fine focus. The potential of the tube and possibly also the anode material should be adapted to the purpose of the investigation and the thickness of the object. The photograph obtained is enlarged in a photomicrograph apparatus. An ordinary photomicrograph is taken of the same section and the two photographs are compared, preferably in a microscope comparator, permitting exact orientation of the blackened parts of the roentgen photograph in relation to the ordinary photomicrograph. In the second method, an enlarged picture of the object is obtained directly on the photographic film. Diagrams illustrating the two methods are given.—*Audrey G. Morgan.*

Jacobsen, I. C., and Ambrosen, Johan. Measurement of the radiation to which roentgen and radium workers are exposed. *Acta radiol.*, 1936, *17*, 252–255.

This article reports measurements of the radiation to which workers in a roentgen department and those engaged in the packing of radium are subjected in the course of a day. The measurements were carried out regularly for a period of three months. It was found that the roentgen-ray workers were subjected to a radiation of between 0.02 and 0.3 r per day. The radiation to which they were exposed in the packing of radium was roughly 5 to 10 times higher.—*Audrey G. Morgan.*

Sievert, Rolf M., and Forssberg, Arme. The time factor in the biological action of roentgen rays. *Acta radiol.*, 1936, *17*, 290–298.

The authors describe investigations of the death rate of *Drosophila* eggs after irradiation with about 165 r for very short periods varying from 0.39 to 1.16 seconds. This corresponds to radiation intensities of 24,000 to 7,800 r/min. They compare the results with those previously obtained with the same doses given in from 2.1 seconds to 30 minutes. A critical study of the possible sources of error indicates that it is probable that the irradiation effect decreases with very short irradiation times. The experiments show that the death rate is reduced by more than 20 per cent with a time of 0.39 second. The authors believe, however, that experiments with greater intensities are advisable in order to confirm the results.—*Audrey G. Morgan.*

Lucherini, Tommaso. Tonsillografia e linfografia cervicale. (Tonsillography and cervical lymphography.) *Radiol. med.*, June, 1936, *23*, 445–451.

The author injected 1.5 c.c. thorotrast into the body of the tonsils in 2 patients in order to study the lymphatic connections between the palatine tonsils and the lymph glands of the neck. Roentgenograms are given showing the findings. The roentgenograms showed the palatine tonsils very clearly (tonsillography) and the direct lymphatic connections between them and the cervical lymph glands (cervical lymphography). Such experiments not only contribute to a knowledge of the diffusion of the efferent lymph currents but also make it

possible to study the methods of transmission of bacteria through the tonsils.—*Audrey G. Morgan.*

TIMOFÉEFF-RESSOVSKY, N. W. Auslösung von Vitalitätsmutationen durch Röntgenbestrahlung bei Drosophila melanogaster. (Production of mutations in vitality by roentgen irradiation of *Drosophila melanogaster.*) *Strahlentherapie*, 1934, *51*, 658–663.

By the use of a special method of crossing which the author has described in a previous article, it was found that by the roentgen irradiation of *Drosophila melanogaster* male mutations could be produced in the x-chromosomes of the spermatozoa which decreased the vitality of the males without causing any visible morphological changes in them. These mutations which changed vitality were produced 2 to 2½ times as frequently as the ordinary lethal and sublethal mutations.—*Audrey G. Morgan.*

KLÖVEKORN, G. H. (Die Epilationsbestrahlung der Kaninchenhaut. (Epilation irradiation of the rabbit's skin.) *Strahlentherapie*, 1934, *51*, 689–696.

The author's work at the University Skin Clinic of Bonn shows that the rabbit is not a good experimental animal for epilation. It requires a very high dosage to cause epilation. Epilation takes place with doses of 840 to 2,100 r in from eighteen to thirty-five days. Erythema does not take place within this time. With doses of more than 1,050 r there was slight desquamation of the skin persisting for about two weeks. There was no necrosis of the epidermis in any case.

Moreover, individual rabbits showed very great differences in reaction with the same dose. This was probably due to difference in the races and individual differences in the fur at different times of the year.

The epilation dose for man is about 340 r with a filter of 0.5 mm. aluminum. The dose required for the rabbit therefore is 2½ times as large as that for man.

Histological examination showed that all the tissues of the skin were affected. There was always cell degeneration of the root sheaths and hair follicles. The appearance of fibroblasts around the follicle is a certain sign that epilation will occur. A marked effect of the rays is changes in the vessels even with doses that do not cause epilation. Large doses at first stimulate pigment formation by the basal cells but apparently later abolish the pigment formation of the germinal layer entirely. The elastic fibers are also injured by the action of the rays, while the sebaceous glands apparently are not affected at all.—*Audrey G. Morgan.*

BECKER, J. P. Photochemische Veranderungen von l-Asparginsäure, l-Aspargin und chemisch verwandten Substanzen durch Röntgenstrahlen und ultraviolettes Licht. (Photochemical changes in l-asparginic acid, l-aspargin and chemically related substances by roentgen rays and ultraviolet light.) *Strahlentherapie*, 1934, *50*, 357–363.

After roentgen irradiation of l-asparginic acid when the substance is dissolved in decinormal sodium hydroxid solution a characteristic maximum (265mμ) appears in the spectrum. After roentgen irradiation of compounds closely related chemically to l-asparginic acid (l-aspargin, malic acid, succinic acid) this maximum does not occur. These findings indicate that the sensitiveness of the building stones of living substance to roentgen rays are closely related to the chemical constitution of these building stones.

l-aspargin does not show any essential change in the spectrum after roentgen irradiation. But after roentgen irradiation in an aqueous solution a characteristic absorption maximum appears (275mμ). This shows that a change in the solvent may have a decided effect on the action of roentgen rays.

A solution of l-asparginic acid in decinormal sodium hydroxid shows the same characteristic maximum in the absorption spectrum after irradiation with ultraviolet light as after irradiation with roentgen rays. This is further evidence that there is no essential difference in the action of roentgen rays and ultraviolet light.

If l-aspargin in solution is irradiated with ultraviolet light the maximum that occurs after roentgen irradiation is not seen, but the effect of ultraviolet irradiation on the solution is like that of roentgen irradiation on the powder. This shows that the solvent may cause differences in the action of the two kinds of irradiation that are not to be attributed to the dissolved substances.—*Audrey G. Morgan.*

PICKHAN, A., and ZIMMER, K. G. Beobachtungen über ungleichmässig gefüllte Radiumpräparate. (Observations on radium

preparations that are not filled uniformly.) *Strahlentherapie*, 1934, *50*, 516–519.

The authors found from observation of a large number of radium preparations that these are frequently not filled uniformly. This is a serious matter, especially with needles and contact irradiations, as it may make the calculation of the isodoses at a distance of 15 mm. from the preparation inaccurate. A method of examining the preparations to determine whether or not they are filled uniformly is described.—*Audrey G. Morgan.*

Zimmer, Karl G. Ein Beitrag zur Frage nach der Beziehung zwischen Röntgenstrahlendosis und dadurch ausgelöster Mutationsrate. (The relation between the dose of roentgen irradiation and the mutation rate produced by it.) *Strahlentherapie*, 1934, *51*, 179–184.

An evaluation of the irradiation experiments made by various investigators on the eggs of *Drosophila melanogaster* shows that there is an exact linear proportion between the mutation rate and the dosage. The apparent deviations from this rule on the use of large doses may be explained as a phenomenon of saturation due to the method of experiment used and can be corrected mathematically. A detailed table for the correction of mutation rates found experimentally is given.—*Audrey G. Morgan.*

Hasché, E., and Collier, W. A. Über die Beeinflussung bösartiger Geschwülste durch Ultrakurzwellen. (The effect of ultrashort waves on malignant tumors.) *Strahlentherapie*, 1934, *51*, 309–311.

Experiments on mice are described in which mice were inoculated in different ways with Ehrlich's mouse carcinoma. They show that irradiation of mouse carcinoma by the usual technique for irradiation with ultrashort waves of 3.5 meters wave length does not affect mouse carcinoma either on general irradiation, local irradiation or irradiation in vitro.—*Audrey G. Morgan.*

Gilardoni, Arturo. Del rendimento radiografico. (Roentgen yield.) *Radiol. med.*, July, 1936, *23*, 545–551.

The intensity of radiation increases theoretically in proportion to increase of the current (ma.) which traverses the tube. But in practice it is not possible to increase the intensity of the radiation beyond a certain limit by increasing the milliamperes. A curve is given showing the point to which intensity increases and then its gradual decline to a point where it does not traverse the walls of the tube.

The author explains his method of calculating by the use of a photometer with photoelectric cells the maximum intensity to be attained by a given tube. The description is extremely technical and accompanied by graphs and mathematical calculations.—*Audrey G. Morgan.*

Engelstad, Rolf Bull. Haben die kosmischen Strahlen nachweisbare biologische Wirkungen? (Do the cosmic rays have demonstrable biological effects?) *Strahlentherapie*, 1934, *51*, 672–674.

The author describes experiments on white mice made in an effort to determine whether the cosmic rays have demonstrable biological effects on growth. He experimented with 438 animals for about ten months. While further experiments will have to be made before reaching absolute conclusions, he excluded all sources of error as far as possible and believes he is justified in concluding that the cosmic rays have an inhibiting action on growth, or at least on the biological functions that result in a gain of weight. But, on the other hand, the experiments indicated that deprivation of the cosmic rays does not have any serious effects.—*Audrey G. Morgan.*

Koch, Franz. Biologische Untersuchungen über Grenzstrahlen. (Biological studies of grenz rays.) *Strahlentherapie*, 1934, *51*, 541–566.

The reactions which take place in the skin after irradiation with grenz rays are not suitable for purposes of dosimetry. The reason for this is that different individuals show varying degrees of sensitiveness to these rays, caused by anatomical differences.

But the lens esculenta is extraordinarily well adapted for the biological measurement of these rays. It reacts very sensitively to increased dosage.

The highest dose at one sitting (2,500 r) calculated on the basis of the dose that inhibits growth in lentils agrees very well with practical experience. Vohwinkel found that in general the dose that inhibits growth in lentils is about 60 per cent higher than the skin erythema dose. This maximum dose can be given, following the

rules for administering the skin erythema dose of short wave roentgen rays without injury.

The mitosis curve after complete injury of lentils by grenz rays shows a peculiar curve that differs somewhat from the curve for roentgen rays and radium.

As shown by experiments on lentils and on the skin, there is an increase of the biological action of grenz rays with increasing hardness, contrary to the conditions seen with hard roentgen rays. It is not true of grenz rays that the same physical doses have the same biological effects. With a very slight change in the quality there is a change in the biological effect even with the same doses.—*Audrey G. Morgan.*

GRONCHI, VIRGILIO. Experimentelle Untersuchungen über die Wirkung der Röntgenstrahlen auf die Hefegärung. (Experimental study of the effect of roentgen rays on yeast fermentation.) *Strahlentherapie*, 1934, *51*, 319–338.

Experiments are described which show the effect of roentgen irradiation on the fermentative capacity of *Saccharomyces cerevisiae* in the presence of glucose. Many experiments showed the following results. Roentgen rays of 0.37Å and 0.16Å in doses of about 600 to 1,800 r have a stimulant action on the function of *Saccharomyces* manifested by increased rapidity of CO_2 production. Other things being equal, this stimulant action is proportional to the intensity of the radiant energy. With equal dosage and other conditions equal, this stimulant action is greater with hard than with soft rays. —*Audrey G. Morgan.*

MISCHTSCHENKO, I. P., and FOMENKO, M. M. Der Einfluss der Röntgenstrahlen auf das Auftreten komplementbindender Körper im Blut. (The influence of roentgen rays in producing complement-fixing bodies in the blood.) *Strahlentherapie*, 1934, *50*, 167–178.

The authors describe experiments which show that the roentgen rays break down the protein molecule into its simplest constituents and that these simple substances act as antigens. The technique of the experiments is described. The Bordet-Gengou reaction was tested and it was found that these antigens produced antibodies. These were not specific, however, as the Wassermann reaction was always negative.

The nature of these antigens is discussed, though not much is definitely known about it.

Radiotherapy evidently represents a sort of endogenous protein therapy, different from the exoprotein therapy with proteins introduced into the body from outside. The optimum dose for the production of antibodies is about 60 per cent of a skin erythema dose.—*Audrey G. Morgan.*

HAYER, E. Ergebnisse von experimentellen Studien am peripheren weissen Blutbild nach Röntgenbestrahlung. (Results of experimental studies of the peripheral blood picture after roentgen irradiation.) *Strahlentherapie*, 1934, *50*, 193–236.

The author gives protocols of his experiments on dogs and curves showing the details of the results. Dogs were irradiated in different locations and with different field sizes and the effect on the white blood picture and its oxydases observed over a period of several weeks. Functional tests were also made at different intervals after the irradiation by the production of sterile abscesses.

The irradiation of a relatively small field at the periphery (thigh) led to a brief decrease of lymphocytes, followed quickly by a transitory increase of all types of cells. The course of a sterile abscess produced at any period after the irradiation was normal.

Irradiation of the spleen led to marked decrease of the cells persisting for some weeks; at first, only the lymphocytes were decreased and then the neutrophile cells to a much greater degree. In these cases, too, the production of a turpentine abscess caused the changes in the peripheral white blood picture that are characteristic of this form of abscess. But the production of the abscess was delayed and it underwent retrogression without perforation, the more so the nearer the production of the abscess was to the irradiation.

In local irradiation the direct, and especially the indirect, action of the rays on the white blood picture was dependent not only on the localization of the fields with reference to the blood-forming organs but also on the size of the fields.

Total irradiation of the animals caused great injury of all the tissues involved in peripheral blood formation, manifested by a great general decrease in leukocytes persisting for weeks. At first, there was a rapid fall of lymphocytes, followed by a decrease of eosinophiles and neutrophiles; the latter continued to fall after the lymphocytes had begun to increase again.

The general injury was such that after some weeks a turpentine injection did not have the usual effect, even when the blood picture had apparently been restored to normal. There was no abscess formation or only a very incomplete one. The effect in this respect was more marked, the closer together the irradiation and the turpentine injection.

Local irradiation caused a temporary increase in the oxydase in the cells circulating in the blood, while in total irradiation, when the large dose of 600 r was given, the oxydase was distinctly decreased.

The dogs that were irradiated locally did not show any visible general effect of the rays. The dogs that were given total irradiation were very limp and would not eat for two or three days after the irradiation; they lost weight for weeks and their hair became bristly.

The turpentine injections had a marked general effect no matter whether the typical blood changes and abscess were produced or not.

Except for one of the totally irradiated dogs, which died of extensive submucous intestinal hemorrhages probably caused by the irradiation, all the other dogs were alive ten weeks after the end of the experiments, had apparently recovered well and their blood picture was approximately normal.—*Audrey G. Morgan.*

Brøchner-Mortensen, Knud. Untersuchungen über den Einfluss der Röntgenbestrahlung auf den Blutzucker bei Menschen. (Study of the effect of roentgen irradiation on blood sugar in man.) *Strahlentherapie*, 1934, *51*, 675–684.

Experiments in determining the effect of roentgen irradiation on blood sugar are described and tables given showing the details of the results. In some cases after a single irradiation there was a rise in blood sugar that was absolutely and relatively somewhat greater than normal and was probably more than could have been caused psychically.

When fasting morning blood sugar was determined throughout a whole period of irradiation the values found were normal. On giving intravenous glucose injections followed by large doses of radiation the course of the blood sugar curve was normal.

Therefore it was impossible to demonstrate the marked effects of roentgen irradiation on blood sugar that have been reported in the literature.—*Audrey G. Morgan.*

Held, A., and Hülbach, H. Der fibrinogenspiegel des Blutes unter dem Einfluss von Röntgenbestrahlung und die primare Strahlenwirkung. (The fibrinogen content of the blood under the influence of roentgen irradiation, and the primary action of the rays.) *Strahlentherapie*, 1934, *51*, 664–671.

The hemostatic action of roentgen irradiation is due partly to the action of the rays in increasing the amount of fibrinogen in the blood. The reaction of the body after roentgen irradiation shows two phases—first a very transitory fall followed by a gradual and long-continued rise of the fibrinogen content of the blood. The second phase of the action of the irradiation is attributed to the effect of products of reaction of the irradiation on the reticulo-endothelial system which has previously been shown to be the source of the production of fibrinogen. The first phase is attributed to a direct action of the rays on the blood, on the basis of experimental irradiations of the dog's spleen which was exposed by operation but left connected with the circulation.

The idea of a primary action of the rays is discussed and attributed not only to the cells but is considered a complex reaction on the cells and the surrounding fluid (blood or lymph).—*Audrey G. Morgan.*

Nemenow, M., and Gurewitsch, R. Über die Wirkung der intravenösen Radoninjektion auf das Blut. (The effect of intravenous radon injections on the blood.) *Strahlentherapie*, 1934, *50*, 693–704.

The author describes experimental work in which the effect of intravenous radon injections on the blood was tested in rabbits. The experiments are described in detail and illustrated with graphs showing the course of the blood counts.

It was found that a single injection of 130–150 mc. radon was fatal for the adult rabbit. After a single injection of 20 to 30 mc. radon the number of leukocytes was considerably decreased, after a slight rise in some cases. The decrease increases with the size of the dose, even to complete aleukocytosis. The decrease of leukocytes begins one-half to one hour after the injection. With moderate doses, the number of leukocytes continues to fall for four to six days and reaches very low values. It then gradually rises, and after twelve to twenty days reaches the original figure. With large fatal doses the leukocytes disappear completely.

The decrease of leukocytes was chiefly at the expense of the small lymphocytes; they decrease absolutely and relatively, while the granulocytes increase absolutely and relatively. The number of large lymphocytes also decreases. When regeneration begins, the large lymphocytes are changed into medium-sized ones quite rapidly, while transformation of the latter into the small forms takes place more slowly. Sometimes the large and medium-sized cells begin to increase while the lymphocytes are still decreasing.

Among the blood-forming organs, the lymph follicles and spleen were most seriously injured. The bone marrow was not injured so much and regenerated more rapidly. The erythrocyte count showed almost no change.

From the practical point of view the intravenous injection of radon does not promise to be of any value in malignant tumors. It seems more hopeful in lymphatic leukemia. For reasons of caution the authors used too small doses in their experiments in this field at first. They are now continuing the experiments with larger doses.—*Audrey G. Morgan.*

STREIMER, LUDWIG, and FINK, R. Untersuchungen über die Beeinflussing des Blutkalkspiegels. (Studies on influencing the blood calcium content.) *Strahlentherapie*, 1934, *50*, 705–713.

This article deals with the influence of a combination of ultraviolet irradiation or sunlight and diet on the calcium content of the blood. This combined treatment, using substances in the diet which increase calcium, such as vigantol, parathyroid extract and calcium, as a rule did not give any higher values than irradiation alone. A combination of irradiation and Sauerbruch-Hermannsdorf diet led to a decrease of calcium, which must have been due to the diet as general irradiation alone increased the calcium content. This diet alone generally had no effect on blood calcium. Among the different kinds of light, sunlight seemed to have the promptest and most pronounced effect on the blood calcium content.—*Audrey G. Morgan.*

MUCK, O. Ein biologischer Nachweis der Strahlenwirkung des Kaliums auf das vegetative Nervensystem. (A biological demonstration of the action of potassium irradiation on the vegetative nervous system.) *Strahlentherapie*, 1934, *50*, 471–475.

It has been shown by changes in the special adrenalin reflex experiment on the mucous membrane of the nose that certain metals have a radioactive effect on the vegetative nervous system. This experiment was tested 40 times on 7 different individuals with potassium. The potassium was not allowed to touch the surface of the body but was held at a distance of 1 to 1.5 cm. from the volar side of the forearm in the region of the radial pulse. The reflex action on the mucous membrane of the turbinates after the exposure to the potassium for a quarter of an hour instead of showing its usual appearance showed the "white stripe" appearance. This appearance was seen in all the experiments. That it was really caused by the radiant energy of the potassium was shown by control experiments with sodium, all of which were negative. The results were also negative when a lead plate 4 to 5 mm. thick was placed between the potassium and the skin of the subject. As with other radioactive substances the disturbance of tonus persisted for three to five weeks. The vasomotor reflex phenomenon of the white stripes was more marked on the side exposed to the irradiation than on the other side.—*Audrey G. Morgan.*

FICHERA. Die biologische Krebsbehandlung und ihre Beziehung zu der Strahlentherapie der Geschwülste. (The biological treatment of cancer and its relation to the radiotherapy of tumors.) *Strahlentherapie*, 1934, *50*, 302–311.

For some years the author has been studying the results of implantation of tumors in different organs. He found that some organs stimulate the growth of the tumor, others inhibit it. The spleen is an example of an organ that is very resistant to tumor growth. In general, organs that are rich in reticulo-endothelial cells are resistant to tumors. He also found that treatment of animals by implantation of tissues, such as spleen, thymus, bone marrow and lymph glands prevented or slowed the taking of implanted tumors. He found further that tumors that had already developed receded under treatment with extracts of these organs.

He then tried combined treatment with these organ extracts and roentgen therapy. He has used this combined treatment in 133 cases in the course of about four years. He found that this combination of roentgen therapy and organotherapy gave good results in cases which experienced roentgenologists had found resistant to roentgen therapy alone; in cases

which were being treated solely for psychic reasons but were otherwise hopeless, and in cases in which the organotherapy had already brought about partial disappearance of the tumor. Eight illustrative cases are described. He believes that this combined treatment may give good results in some cases in which either treatment alone is not effective.—*Audrey G. Morgan.*

Fischer, Albert. Die Biologie der Krebszellen "in vitro." (The biology of cancer cells in vitro.) *Strahlentherapie*, 1934, *50*, 79–90.

Until recently cancer research was in the same position as the study of infectious diseases was before the bacteriological era. But it has become possible now to study the biolcgy of the cancer cell by means of the technique of tissue culture and the demonstration of the cell respiration of the cancer tissue.

The malignant properties of cancer tissue are due to specific cancer cells. No qualitative differences have so far been demonstrated between normal cells and malignant cells. The cancer cells differ only quantitatively from the normal cells in respect to their capacity for glycolysis and proteolysis and their capacity for building up new protoplasm from the blood plasma as their only source of nutrition. The same rules hold good in the transplantation of tumor cells as in the transplantation of normal cells.

The author's method of cultivating tumor cells under conditions approximating those in the body, that is, without the addition to the culture medium of substances that stimulate growth, gave him a great deal of insight into processes of regeneration and intensity of growth. It was found that the growth of the cultures was greatly stimulated when small wounds were made in them. The experiments showed that the mechanism of tumor growth is the same as that of all physiological processes of regeneration. The presence of certain tissue cells and leukocytes is not a necessary prerequisite for regeneration. When they were wounded the tumor cells grew much more rapidly than the normal cells and their life was short. The tumor cells are only slightly resistant to external influences and are easily destroyed. The lability of the carcinoma cells is shown by the fact that they offer much less resistance to an external injury than the normal cells. This explains why there are so many more mitoses in cultures of tumor cells than of normal ones, although the latter are apparently growing much more rapidly. The unrestrained proliferation of tumor cells in the body is evidently the physiological result of spontaneous cell death, just as normal regeneration is caused by injuries to cells. There is no reason to assume that the growth of tumors is subject to any other laws than those for normal growth. But tumor cells are cells that bear within themselves the germ of their own destruction. They are so labile that they respond by cell division to factors that would not affect normal cells at all.

But though the mechanism of their growth is now well understood the reason for their great lability is still unknown. It will require further research to determine how such a labile race of cells originates. Some radical change in the cell is necessary to transform it into such a type. Such a change might come about through mutation as a result of certain changes in the chromosomes.

Tumor cells from mice can be cultivated through many generations and still show the same properties that they had when removed from the animal body. This shows a sort of fixation of the properties of the tumor cells which can be kept up by cultivation in vitro.—*Audrey. G. Morgan.*

Fischer-Wasels, Bernh. Die Bedeutung der besonderen Allgemeindisposition des Körpers für die Entstehung der Krebskrankheit und die Möglichkeiten ihrer Bekämpfung. (The importance of general bodily predisposition in the causation of cancer and the possibilities of combating it.) *Strahlentherapie*, 1934, *50*, 5–78.

The author discusses the general nature of cancer and the development of cancer cells from normal body cells. Among the methods suggested for the possible prevention of cancer, the chief ones are diet and the various methods of stimulating the reticulo-endothelial system. Prevention of pathological inheritance is also mentioned as a possible factor. He maintains that alkalosis is one of the primary factors in producing cancer and that therefore an acid diet tends to prevent it. The diet should be poor in vitamins, particularly vitamin B and poor in cholesterin. It must also be of such a nature as to prevent retention of water in the body and the putting on of fat.

Preventive measures need not be begun before the age of forty unless the subject has a

family history of cancer. There are various methods of stimulating the functional activity of the reticulo-endothelial system, among them various methods of heating and stimulating the spleen. This may be attained by diathermia or short wave treatment of the spleen at intervals of about three months. Activation of the reticulo-endothelial system may also be brought about by a general rise of temperature as in artificial fever therapy. Another method is that of weak general irradiation of the body with roentgen rays. Small doses of roentgen radiation inhibit the taking and growth of the tumors in experimental work on mice. The best results are attained with an interval of about a month between the implantation and the irradiation. There is danger of paralysis of the reticulo-endothelial system by overdosage. Intense and frequent irradiations injure the bactericidal action of the tissues and organs, weak and infrequent irradiations stimulate them, particularly those of the liver and spleen.

Another useful method is compression of the spleen by physical exercise. It does not do anyone any harm to do fifteen minutes gymnastic exercise on getting up in the morning. Intramuscular injections of the patient's own blood at about six-month intervals is also to be recommended. This probably stimulates the reticulo-endothelial system more intensely than any of the other methods suggested.

All these are suggestions that have been supported by observations on man and animals. The author thinks the carcinoma problem should be considered from this point of view more seriously than it has been heretofore. Most physicians are inclined to dismiss such attempts as hopeless. But Fichera has not simply left patients with inoperable carcinoma to their fate but has tried to utilize the known facts in regard to defensive substances in the spleen, thymus, etc., in treating them. Though his results have not been brilliant, numbers of individuals have had their lives lengthened for years by these methods. The author is anxious to stimulate the interest of physicians in general treatment for cancer and believes such general measures should be used both in prevention and in the treatment of inoperable cases. —*Audrey G. Morgan.*

ROSSELET. August Rollier. *Strahlentherapie*, 1934, *51*, 193–200.

A brief sketch of the life of Rollier and a bibliography of his works and those of his coworkers, in honor of his 60th birthday.—*Audrey G. Morgan.*